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## Diseases of the Typhus Group in North America\*

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IT has become evident from research carried on in many countries in the past few years that three diseases, typhus—long associated with European military history, tsutsugamushi—apparently a native of Asia, and Rocky Mountain spotted fever—a native of the Western Hemisphere, are so closely related to each other as to warrant their being considered as belonging to a single group of which typhus may be considered the type disease. The members of this group are often referred to as rickettsial diseases, since rickettsia have been found in more or less constant association with them and are generally regarded as being the causative agents. A number of other diseases, whose exact relationship to these three is not thoroughly understood at present, have been described from widely separated localities. Thus boutonneuse fever of the Mediterranean regions and "Kenya typhus" in East Africa are closely related to spotted fever, while the pseudo typhus of Delhi and Sumatra and the scrub typhus of the Federated Malay States are akin to tsutsugamushi, if not identical with it. To further complicate the picture, typhus, as we now understand the disease, may be divided into two forms—an epidemic or louse-borne form, and an endemic or flea-borne form.

Of this typhus group or family, two members are endemic in North America—Rocky Mountain spotted fever and endemic typhus.

### ENDEMIC TYPHUS FEVER

For something like a third of a century, it has been known that endemic

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typhus fever is present in the United States. The clinical, serological and immunological identity of this disease with epidemic typhus of the old world has long been established, while the epidemiological differences between the two types have been stressed by various writers on the subject. The more severe type of typhus known to the literature as classical typhus, old world typhus, louse-borne or epidemic typhus, and by such apt names as jail fever and ship fever, has been introduced into Canada and the United States from time to time in connection with immigration from Europe or from Mexico but has never gained a permanent lodging.

#### *Differences from Old-world Epidemic Typhus*

The differences which set this epidemic form of typhus apart from the milder endemic form which is constantly present in the United States, may be summed up very briefly. The disease is often associated with war, famine and human misery; it occurs first and is most frequent in the squalid sections of cities; it is remarkably contagious; it is a disease of winter and spring and is associated with lousiness. The endemic form of typhus shows a contrast. It does not preponderate in the poorer sections of cities; it is not known to spread from person to person; it is a disease principally of the late summer and fall, and is not associated with lousiness. In addition, endemic typhus is definitely associated with handling of foodstuffs. The epidemiological differences between epidemic and endemic typhus were readily explained when it was shown that the rat flea is the vector of the endemic form of the disease, and that a reservoir of the disease exists in nature in Norway rats.

#### *Incidence in North America*

Mild typhus was described in New York City in 1898, and was recognized in the Southern States somewhat later, being reported in Atlanta in 1913, in Charlotte, North Carolina, in 1914, and in Galveston, Texas, in 1916. It is now known to be widely distributed over the world, and is variously known as Brill's disease, endemic typhus, murine or rat typhus and flea typhus.

In 1923, intensive studies of the disease in our Southern States were started. In 1929, it was known that the disease was rather sharply limited to the seaboard, being present in nearly all of the Atlantic seaports, from New York, southward. On the Gulf Coast, it was endemic in Tampa, Pensacola, Mobile, New Orleans, Galveston and Houston, Texas, and in the lower Rio Grande Valley. With one or two exceptions, the disease was concentrated in the coastal cities and towns and had not, in general, been recognized very far inland. For instance, in Alabama, the disease, although present every year in Montgomery, was not found in the towns north of that city. On the other hand, it was of common occurrence in the towns of the southeastern part of that State. Throughout the area in which endemic typhus was recognized at that time, it was essentially a disease of the cities and towns. In the succeeding six years, the disease has spread until at present we find it as far north as Tennessee and Northern Texas. Coming north along the Atlantic seaboard,

we find that the disease is still limited to the coastal towns and has not shown the same tendency to spread inland as we have observed in the more southern States.

With the extension of the geographical limits of the disease, there has been a marked increase in the number of cases reported each year. Fifty cases were reported for the Southern States in 1923, the first year in which an intensive study was made in that section. Each succeeding year brought a gradual increase in the number of reported cases, until 300 cases were reported in 1931. In 1932 there was a sharp increase in the number of reported cases for the entire South to the figure 831, followed in 1933 by 1922 cases with a slight recession in 1934 and 1935 to 1308 and 1195 cases, respectively. The gradual increase in the number of reported cases from 1923 to 1931 might be explained by increased recognition of cases by physicians, as interest in the disease spread, but the sharp increases in 1932 and 1933 surely cannot be explained on those grounds alone.

Coincident with the increase in number of cases, there has been an extension of the disease from the cities and towns to the rural districts. This rural involvement has not occurred over the entire South, but has been limited to certain sections, chiefly to the counties in Southern Alabama, and Georgia, where peanuts are grown extensively. It has been suggested that the cultivation of peanuts and their subsequent storage in the rural districts has attracted rats from the towns. Such an increase in the rural rat population may be the basic reason for the increase in cases of endemic typhus. A second reason is suggested by the history of bubonic plague on the Pacific Coast. This epidemiologically similar disease was introduced to the West Coast in rats, but a reservoir became established in the native ground squirrels. It seems not unlikely that something of that sort may have happened with typhus in the Southern States. With this in mind, we have undertaken a study of native wild rodents of the South to determine their susceptibility to typhus fever and consequently the possibility of any species of native rodents serving as a reservoir of the disease. To date, practically all of the rodents native to the Southern States that have been examined have been proved susceptible: two species of meadow mice, white footed mice, house mice, chipmunks, one species of squirrel, rice rats, cotton rats and o'possums.

#### ROCKY MOUNTAIN SPOTTED FEVER

The second member of the typhus group, endemic in North America, is Rocky Mountain spotted fever, which, as the name indicates, was first described in North America, and until comparatively recently, was thought to be limited entirely to the northwestern part of the United States.

Spotted fever is known to have been present among the early white settlers in Montana and Idaho for fifty or sixty years. From Indian legends it seems probable that the disease was encountered by the Indians prior to the advent of the whites. The epidemiology and mode of transmission of the



FIGURE 1. Distribution of epidemic typhus fever in the United States, 1935.

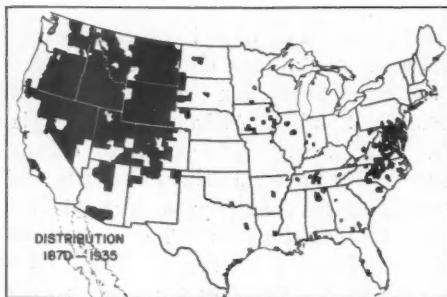


FIGURE 2. Distribution of Rocky Mountain spotted fever in the United States, 1870-1935.

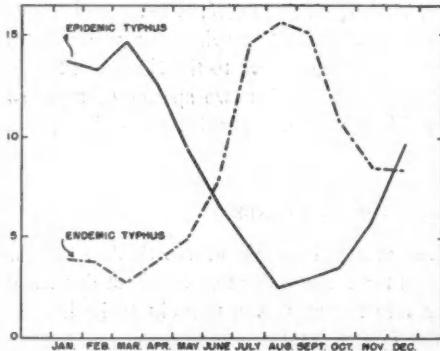


FIGURE 3. Seasonal distribution of 5,334 cases of endemic typhus fever in the United States, 1932-1935, compared with 180,000 cases of epidemic typhus in Europe, 1930-1935.

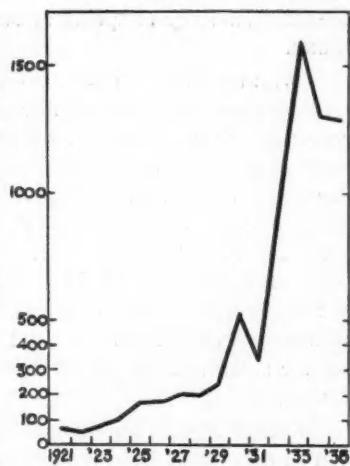


FIGURE 4. Endemic typhus fever cases reported in the United States each year, 1921-1935.

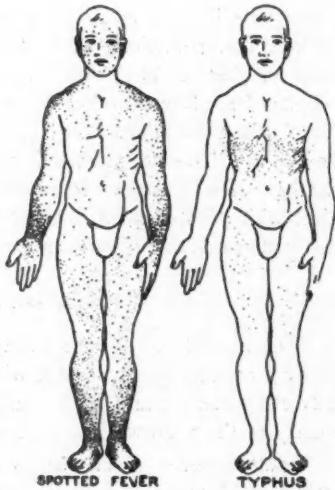


FIGURE 5. Typical distributions of rash.

disease have been accurately recorded by a number of investigators. It has been shown that the disease can be transmitted experimentally by several species of ticks, and that at least two species, which feed upon man, are infected in Nature. The known vectors are the *Dermacentor andersoni*, the wood tick of the Northwestern States, and the *Dermacentor variabilis*, or eastern dog tick. In these two ticks, both of which readily feed upon man, the virus of spotted fever is hereditary, a fact which greatly increases the difficulties of control.

#### *Distribution in North America*

In the early years of this century, spotted fever was thought to exist only in the Northern Rocky Mountain States, but within the past ten or twelve years the disease has been recognized as wide-spread over the entire United States, with the exception of the New England States, Michigan and Wisconsin. It is also present in at least two of the provinces in Western Canada—British Columbia and Alberta. In addition, it has been shown that the so-called "exanthematic typhus of Sao Paulo", Brazil, is indistinguishable from spotted fever and immunological studies have indicated that boutonneuse fever is very closely related. The suspicion has been voiced that Kenya typhus of the province of Kenya in East Africa, a tick-borne disease, may also be very closely related or even identical with spotted fever.

Confining ourselves to the known infected region in North America, it is a matter of interest whether the increase in the known geographical limits of the disease represents an actual dissemination, or can be explained by an increased recognition of cases. We are unable to answer this question at the present time. The list of animals that are known to be susceptible to spotted fever embraces several species of squirrels, rats, mice and rabbits, woodchucks and large animals as the dog and sheep.

It would seem that since this disease is hereditary in ticks and since the opportunities for the dissemination of infected ticks on dogs, sheep, rodents, etc., are numerous, the increase in the known distribution of the disease must be real. On the other hand, we know that the disease was occurring in human beings in the Eastern part of the United States for at least 15 years before it was recognized.

The number of cases reported each year since the recognition of the fact that the disease is widely distributed over the United States, has remained at a figure a little short of 1,000 cases. The great majority of these come from the originally known area in our Rocky Mountain States. There is a wide variation in the virulence of the strains of spotted fever as shown by the mortality rates in human beings. Cases occurring in certain districts—as Southern Idaho—give a mortality rate of less than five per cent, while in certain sections in Montana the rate reaches 75 per cent. In the infected areas in the east and in the United States as a whole, the mortality rate is 20 to 25 per cent.

*Transmission by Ticks*

The incidence of human cases of the disease closely follows the prevalence curve of the tick. Consequently, the disease is chiefly a disease of spring and early summer, being somewhat earlier in the Northwest than it is in the East. *Dermacentor andersoni* appear in Montana in February or the latter part of January, and a few can be found as late as August or September. They are most prevalent from the middle of March to the middle of June. In the eastern States the season for *Dermacentor variabilis* is about one month later. The life cycles of these two *Dermacentors* are similar. The adults, male and female, emerge from their winter hiding places under leaves and brush in the first warm days of spring, and crawl up on grass or bushes and wait for some host to pass. Attaching to the host, they feed to engorgement, the process of fertilization of the female by the male taking place at this time, after which the female drops to the ground and deposits her eggs. These eggs hatch into small six-legged larvae which sometimes are called seed ticks. These larvae seek grass or bushes as vantage points to await suitable hosts to which they attach. After feeding to engorgement, these larvae drop to the ground where they moult to nymphs. The nymphs repeat the same performance of seeking a host, feeding and moulting and emerge as adults. In nature, the climatic conditions and availability of food supply affect the duration of the tick cycle. It probably takes an average of two years to complete the cycle from adult to adult. The winters are passed in one of the flat or unfed stages, probably as the unfed adult or nymph in most instances, as these stages readily withstand extremes of temperature and humidity.

*Clinical Course in Man*

The diagnosis of spotted fever in the human being is usually made on clinical grounds as definite laboratory proof of infection is a tedious procedure not to be undertaken by the usual clinical laboratory.

In man the disease has an incubation period of two to twelve days, most often being a week or a little less. The actual onset may be preceded by a few days of ill defined prodromata—loss of appetite, listlessness or headache. The onset is usually sudden with a chill or chilly sensations, and rapidly rising fever. Prostration is usually marked. In the more severe cases, nosebleed may occur early. Soreness of the muscles and joints is commonly present. The temperature rises rapidly and shows morning remissions of 1° to 3° F. The temperature reaches its highest point usually in the second week. The termination is by rapid lysis, usually about the twenty-first day.

The most distinguishing characteristic of the disease is the rash. This appears between the second and fifth days, usually on the third or fourth. The eruption is macular, rose red in colour at first, and becomes fainter, almost disappearing during the morning remissions of fever early in the disease. The macules become more distinct each day, becoming definitely petechial early in the second week in all but the mildest cases. In the severe cases the spots become deep red or purplish and confluent. Necroses may develop. The rash

usually persists throughout the febrile period and into convalescence, becoming brownish in colour. A branny desquamation often occurs over the areas where the rash was thickest. The site of the first location of the rash and its spread and final distribution are important in the diagnosis of the disease. The rash first appears usually on the wrists and ankles. It spreads rapidly in the first 24 to 48 hours to the back, then arms, legs, chest, and last to the abdomen, where it is least marked. The palms and soles are frequently involved and occasionally the face and even the scalp is included.

Nervous and mental symptoms are common: restlessness, insomnia, disorientation and in severe cases, delirium. Coma usually precedes death, which often occurs about the end of the second week.

Convalescence in severe cases is apt to be slow and may be complicated by visual disturbances, deafness or mental confusion. Although recovery may be delayed, it is usually complete in the end.

#### DIFFERENTIATION OF ENDEMIC TYPHUS FEVER AND SPOTTED FEVER

In a rather extensive section of the United States, spotted fever and endemic typhus occur side by side, and in these sections spotted fever has been more often confused with typhus than with any other disease. As far as is known at present, typhus is not present in Canada, certainly in the sections where spotted fever has been found. However, it may be well to point out that the general symptoms of the two diseases are the same. The chief differential points are the duration of the fever and the location of the rash. In typhus the fever is usually less than 16 days, while in spotted fever it is usually more than 16 days. Spotted fever is more severe than endemic typhus. This is noted especially in the nervous and mental disturbances, the prostration and the height of the fever. The most important differential point between spotted fever and typhus is in the site of original appearance of the rash and the course of its extension. In spotted fever it has been noted that the rash begins typically on the extremities and extends to the body. The typhus rash is the opposite of this. In typhus the rash begins on the lower chest and upper abdomen. In the mildest cases no extension of the rash from this location may occur. In the more pronounced cases the rash spreads over the upper arms, shoulders, back and down the forearms, and over the thighs. In severe cases the palms and soles may also be involved. The face and neck are seldom involved in typhus. In the mild cases the rash may persist only two or three days, and in the majority of cases, it disappears by the time the temperature reaches normal.

As noted earlier in this paper, the laboratory is of little help in the differential diagnosis between spotted fever and typhus. The white cell count in spotted fever may be 10,000 to 30,000—usually about 12,000 to 15,000. In endemic typhus the count is usually normal or a little less. The Weil-Felix is positive in both diseases. In doubtful cases where the agglutination titre never reaches a high point, the course of the Weil-Felix is valuable, as a waxing titre as the disease progresses is an excellent indication of infection with a disease

of the typhus group. The diagnosis of cases of either typhus or spotted fever is not difficult if the diseases are known to be present in given areas. Definite laboratory proof of the first case in a hitherto unsuspected area is advisable.

For the laboratory identification of a case suspected of being either typhus or spotted fever, the isolation and study of the disease in laboratory animals are essential. The points to be observed are: the clinical picture in guinea pigs, the production of agglutinins to *B. proteus X* in rabbits or monkeys, the presence of the typical histological picture in the brains of animals and cross immunity tests.

For spotted fever, the incubation period in guinea pigs following inoculation with infected blood varies from 2 to 7 days. Occasionally in the milder strains the incubation period may be extended to 8 or 9 days. The type of fever shown by infected guinea pigs varies somewhat with the virulence of the strain under study. In infection with the more virulent Western strains the temperature may reach 41° C. or even exceed that temperature and persists for 7 days to two weeks. The most virulent strains of spotted fever may destroy 80 to 90 per cent or more of all guinea pigs inoculated, while less virulent strains may show a mortality rate of about 20 per cent. The course of spotted fever in the male guinea pig is complicated by a reaction localizing in the genitalia. This does not occur in all strains. In the virulent Western strains this reaction is noted in practically all of the male guinea pigs and is absent in the less virulent strains isolated and studied in the Eastern States. The typical reaction shows as rash in the skin of the scrotum. This starts as a fine macular rash, usually about the third day of fever. Minute haemorrhages occur into the macules which have a tendency to coalesce. If coalescence is extensive and the guinea pig survives, necrosis follows which may be so extensive as to include practically the entire scrotum. The process heals with the formation of scar tissue. During the course of the disease in the guinea pig, the animal loses appetite and sits huddled in the cage with ruffled fur. Emaciation is rapid. Death usually occurs about the end of the first week.

On post mortem examination of guinea pigs dying at the height of the disease the most characteristic finding, other than the scrotal reaction, is an enlarged spleen. The enlargement may be as much as five times the normal. The outer surface is dark red or mottled and smooth.

The typhus reaction in guinea pigs is not as severe as the spotted fever reaction. In fact, uncomplicated typhus does not cause death in the guinea pig, and during the course of the disease, the animal shows no outward signs of sickness, maintaining a good appetite and smooth fur throughout. The incubation period following intraperitoneal inoculation with infective blood varies from 5 to 9 days, with occasional longer periods. Some differences may be noted between the types of febrile reaction caused by epidemic typhus and endemic typhus. With both types, the fever may range in duration from 3 to 9 days, seldom exceeding 40.5° C. and in many instances not exceeding 40.0° C. In occasional guinea pigs, a temperature of 39.8° C. will not be exceeded. Following infection with epidemic typhus, the fever is more regular and apt to

be of longer duration on the average. With both types of typhus, inapparent infections may be encountered. In such instances the guinea pigs show no recognizable reactions to the disease, but the infection may be recovered from the blood after an appropriate incubation period. Like spotted fever, typhus causes a reaction of the genitalia in male guinea pigs. This is of short duration and is infrequent during infection with epidemic typhus, but occurs in over 75 per cent of guinea pigs infected with endemic typhus. The reaction appears as an erythema of the scrotum with an edema of the skin and underlying tissues. This is accompanied by a swelling of the testicles themselves. As a result, they can no longer be pushed through the rings into the abdominal cavity. On post mortem examination, it will be noted that an exudate is present on the tunica vaginalis. Congestion is often present in the blood vessels of the underlying tissues and haemorrhages beneath the testicular layer of the tunica may be present. This scrotal reaction usually begins on the first or second day of fever and persists until defervescence occurs. It never proceeds to necrosis as in spotted fever. It may be well to note that scrotal reactions grossly identical with the endemic typhus reaction may follow intraperitoneal inoculation with some bacteria unrelated to typhus.

The spleen in typhus may be normal in size and appearance, or may show moderate enlargement with an overlying fibrinous exudate.

Both spotted fever and typhus produce agglutinins for *B. proteus X*<sub>19</sub> in the sera of rabbits and monkeys. In the brains of animals infected with either disease are found perivascular infiltrations and the so-called typhus nodes consisting of collections of glia cells.

Animals recovered from spotted fever or typhus are immune to reinfection with the same disease, but neither disease produces immunity against the other.

#### CONTROL MEASURES

Before closing, it may be well to mention briefly the problem of control. Based on the results of rat control measures used in the suppression of bubonic plague in recent years, it would seem that such measures should be applicable to the control of endemic typhus, as long as the disease is confined in nature to the common grey or brown rat. Should some native species of rodents become infected, the problem will be much more difficult if not impossible. In the control of Rocky Mountain spotted fever, many measures directed against the tick have been tried: introduction of tick parasites, cleaning up waste land, burning of brush, etc. In spite of these measures, the tick population and the incidence of human spotted fever remain about the same.

# Discovery of Cases of Active Tuberculosis amongst Ex-patients in a Rural Province\*

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SASKATCHEWAN is predominantly a rural province. We have only four cities of more than ten thousand and none over fifty thousand. The remainder of the population is scattered in rural districts, and small towns and villages are placed advantageously to supply the wants of the rural communities they serve. The total population of approximately 800,000 is living in the southern half of the province. There has been a trend of settlement to the north during the drought years but new districts opened are practically all in the southern half, as the centre of the province and of the Dominion of Canada lies approximately in Prince Albert National Park, at a point some seventy-five miles north of the city of Prince Albert.

Finding cases of active tuberculosis among the ex-patient group in such a population necessitates special measures. Our follow-up method has been developed and perfected as a result of the experience of the past nineteen years. The following is a résumé of that part of the plan which originates in the sanatoria.

All cases of active or suspected tuberculosis are included in the plan. One month after discharge from sanatorium each patient receives a form with special questions to suit his individual needs. Three months after discharge the patient is given an appointment for a review examination. Two examinations are made the first year, with additional examinations if indicated. During the second year one follow-up report is obtained and one examination is arranged either at the sanatorium or elsewhere, as later outlined. Further examinations are carried out in the second year also if the patient's condition indicates it. During the third and fourth years one examination is arranged for, with more if necessary. This might not appear feasible when patients are scattered over an area of about four hundred miles square but on looking at the map one finds that the three sanatoria are placed at advantageous points for railway service. Eight clinics serve strategic points and two travelling consultants visit the family physicians, covering the whole province annually. Sanatorium service is as close to the patient as is his family doctor. Public health nurses visit homes where patients are located at a distance from the physician. Weekly lists of deaths are forwarded to the Saskatchewan Anti-

\*Presented at the Thirty-sixth Annual Meeting of the Canadian Tuberculosis Association, Vancouver, B.C., June, 1936.

Tuberculosis League by the Department of Public Health, permitting of the completing of our records in regard to the cause of death of all ex-patients.

During the first ten years of our follow-up experience the major emphasis was placed on the recovery of function—the disappearance of symptoms and the ability of patients to resume work. In more recent years there has been added a concern regarding the infectivity of the patient. Consequently we have made a definite effort to examine sputa of all review cases and where the patient stated in his follow-up report that he had sputum. A convenient container for mailing sputum to the sanatorium is included with the follow-up letter. Those found to have tuberculosis-positive sputum receive special attention. They are returned to the sanatorium or clinic to determine the cause and also to ascertain what further steps should be taken. This is a very important feature of a follow-up program and relates directly to prevention, which, however, is rather apart from the scope of this paper. That the measures taken in the prevention and control of tuberculosis in Saskatchewan are effective is shown by the rapid fall in the morbidity rate during the past fifteen years and by the fact that fifteen years ago 55 per cent of school children under ten years reacted to tuberculin tests while last year the percentage in some schools was as low as 5.

#### *Travelling Consultant Service*

The family physician is notified two weeks prior to the appointed visit. Ex-patients are requested to be present. The patients whose homes are adjacent to the clinics are advised to report there when the next examination is due. An extensive correspondence is entailed in maintaining the all-important contact with ex-patients and their physicians. This involves the sending of letters of enquiry to patients, with copies of such letters to their physicians, and the replying to the many enquiries received from patients regarding their health.

#### *Results*

During the year 1934, 200 ex-patients were readmitted for treatment and in 1935, 208. Among the contacts to primary cases we discovered 167 new patients in 1934 and 183 in 1935, so that there were actually more active cases readmitted from amongst the discharged group than there were new active cases discovered among the contacts of primary cases. In 1934, 38 ex-patients died in sanatoria and 35 died at home, while in 1935, 35 ex-patients died in sanatoria and 47 at home. Among the 4,000-odd living discharged patients in Saskatchewan there were 47 who suffered a relapse and were readmitted. Eleven others were not readmitted. The patients readmitted, who had not suffered relapses, were those whose disease had not arrived at the apparently arrested stage and were readmitted because their disease had progressed and they needed bed care. During the past two years approximately 30 per cent of those under treatment have been readmission cases. In Dr. Ferguson's study of 1,747 cases during the seven-year period between 1917 to 1924, 76 per cent of the relapses occurred within the two-year period and 88 per cent within the three-year period following discharge.

Follow-up experience proves that the greater majority of relapses among arrested cases occur within the four-year period. The greater majority of deaths among progressive cases occur within this period also. At the present time a survey is being undertaken of the condition of all living ex-patients in the province and wherever a tuberculosis-positive sputum is found we are proceeding to readmit the patient for further observation.

In a study made by Dr. Wherrett in 1930 on follow-up information on 2,031 tuberculous patients one to thirteen years after discharge from the sanatoria, the urgent necessity for a four-year follow-up was stressed, since 84 per cent of deaths occurred in that period. Particular emphasis was placed on the first two years, when 61 per cent of deaths occurred. This is strong evidence of the necessity of maintaining a very close contact with the patient during these two particularly trying years of readjustment. Dr. Wherrett found 10 per cent of relapses in this group, as compared with 11 per cent in the group of 1,747 tuberculous patients studied by Dr. Ferguson, one to seven years after discharge from the sanatorium. There is no particular need to deal with the cause of relapse in this paper other than to say that "insufficient treatment", which was formerly the leader in the list of causes, has become steadily less frequent as more adequate periods of sanatorium treatment have been employed. Dr. Wherrett also points out that sanatorium treatment and follow-up of patients have laid the foundation for the intensive preventive program which is now being conducted among the families and contacts. This preventive program is still of major importance, and while the supervision of ex-patients does not add materially to the growing number of early cases discovered yearly by the services of the League, it must be remembered that there were more active cases discovered among the ex-patients in the past two years than among the contacts of new primary cases. The size of this group of ex-patients may be visualized in the course of a study of 4,000 ex-patients at Fort Qu'Appelle sanatorium in 1935 when 60 cases were found which needed further care and supervision.

At Prince Albert sanatorium in 1934, 17 positive specimens of sputa were found among 116 samples submitted and from this group 11 patients were readmitted. In 1935, 27 positive specimens were found in 147 samples returned, and 18 patients were readmitted. These numbers do not refer to the total number of readmissions to Prince Albert sanatorium for 1934 and 1935 but to those who were found to have a tuberculosis-positive sputum and advised to return for further investigation.

The value of the sputum container for mailing cannot be overstressed. Family physicians are encouraged to make use of the sanatorium laboratories in the diagnosis of respiratory cases. By this method alone many new cases are found. The sending of chest films for interpretation is also encouraged. This results in a closer co-operation between the family physician and sanatorium and the establishment of a confidence which not only takes in the ex-patient group but also the problem of respiratory diseases in general and is reflected in a greater use of our special facilities, much to the advantage of all concerned.

# Requirements for Employment in Public Health Nursing\*

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**W**HAT I am going to say is, for the most part, well known to you; yet, since we represent many different communities where we are all trying to live up to the accepted standards of the requirements for public health nursing, it may be of value to us to consider the various standards and study the direction in which we are moving. We are constantly being faced with the question of whether the requirements should be lowered and nurses should be employed who do not have the background of preparation that we believe is necessary.

In presenting this subject, I wish to perform a trisection of the title "public health nurse" and study separately each of the component parts: firstly, the nurse and her personality; secondly, the program that she is expected to carry out—namely, health; and finally, the public with whom she will work and to whose needs she will minister. From this study we may be able to form a picture of the requirements for employment.

## REQUIREMENTS IN PERSONALITY

The personal qualifications of the nurse are exceedingly important. Since she is to be a teacher of how to lead a healthful life, one of the first requisites is that she should not only be health-minded but should also suggest health in her personal appearance and in her living habits. What salesman would be considered worthy of his hire who did not firmly believe in the value of the wares that he was offering for sale? To an unbelieving public the value of good health must be demonstrated. The nurse should be the embodiment of health.

Of prime importance also is that she should have an interest in and a love for teaching. She must possess the ability to explain coherently, to demonstrate patiently the methods that should be used in caring for infants or older children, and so forth. So often we hear people say, "I would far rather do a thing myself than try to show someone else how to do it." Such persons are not teachers. The ability to teach, to lead others along the road to health, is an important requirement for employment.

Another characteristic for which we look is that the nurse should have an understanding of and a liking for people. Public health nursing is primarily a life of service to others. No nurse is successful who looks with disdain on a

\*Part of symposium, "Personnel in Public Health Nursing Services", presented before the Public Health Nursing Section at the Twenty-fifth Annual Meeting of the Canadian Public Health Association, Vancouver, B.C., June, 1936. Other papers from the symposium will be published in subsequent issues.

less fortunate sister, who patronizingly metes out her instructions, who is not interested in the way her fellow citizens live. To some nurses the ability to make friends comes easily and naturally. In others it is almost lacking. This characteristic can be fostered and developed by anyone who desires it and should be an essential part of the nurse's personal equipment for the position which she desires to procure.

The nurse should have an active yet controlled enthusiasm for nursing in general and for public health nursing in particular. How many of us can recall instances of young nurses who go out to their first appointments burning with zeal to correct, in short order, all the ills to be found? Frequent rebuffs are met and her enthusiasm languishes and finally dies because it is not intelligently directed. Coupled with enthusiasm, then, we look for common sense and good judgment so that she selects the most essential things in any piece of work and does them whole-heartedly. In addition she should have the capacity to carry through to a successful conclusion even the less interesting details.

There are many other qualifications that are equally desirable. She should have a sense of humour that will help her over the rough spots and enable her to keep things in their true perspective, the ability to co-operate, a hopeful outlook on life, and initiative. Many more can be added to the list. The combination of all these attributes constitutes her personality and, depending on the combination present, we characterize her as charming, capable, or forceful.

#### REQUIREMENTS IN TRAINING AND PUBLIC HEALTH

Apart from these personal characteristics, we look for certain other things in the nurse—her training and knowledge of public health. Adequate preliminary education and training in an accredited training school for nurses are recognized everywhere as essential. Let us look a little further. The ability to do the things required of a public health nurse and to avoid falling into certain pitfalls that beset her path, it seems to me, leaving personality out of the question, is based on her store of knowledge. Since her prime function is to teach the principles of public health, she should be thoroughly conversant with such subjects as hygiene, preventive medicine, public health administration, the principles and practices of public health nursing, the structure of society and the way it functions, the principles of teaching, and perhaps one of the most important, psychology and its kindred subject mental hygiene.

Where shall we find the nurse who has this knowledge and training?

#### REQUIREMENTS OF THE PUBLIC

Before we answer this question, let us look over the situation from the point of view of the public. What are the requirements which it presents which the nurse should be prepared to meet? First of all, she must have a public health point of view which will enable her to see the individual as a member of a family and a member of society, and not simply as an isolated individual. She must be able to think of the problems presented by that individual and then think of the family problems of which the individual's problem may be either the cause or the effect. Then she must be able to see

beyond that to the community problem, placing emphasis on prevention and education rather than merely the alleviation of ills already existing. This is not a point of view with which nurses are born or acquire while in training. It is the outcome of special study and experience.

The second demand of the public is for knowledge of how to live. Before she can impart this knowledge, the nurse must know the why and how of proper prenatal hygiene, the facts about the growth and development of the normal child from infancy to maturity in both the physical and the psychological aspects, the proper methods for the control of the common communicable diseases and of tuberculosis, and all the other conditions with which she will come in contact. If she lacks sound, scientific and comprehensive knowledge, her teaching will be a farce. Furthermore, she must have a certain amount of skill in presenting her subject so that it makes an impression, so that it creates an enthusiasm, so that it will bring about a change of heart, so that it culminates in the actual practice of the things which she is advocating.

Thirdly, the nurse must have skill in getting people out to classes, to clinics, and to other centres where she hopes to instruct and help them. The nurse who does not know how to reach the people, does not know how to make them enthusiastic, how to attract them to classes and clinics, how to interest them after they have come and make them wish to come again, is not getting very far with her educational program.

Fourthly, since her greatest opportunity and effectiveness are in the home, she must have an understanding of good home-visiting. She must know why she is going into the home, how to make a successful approach to it, how to take in the situation when she gets there, and how to "get over" the right ideas and influence the situation constructively. Very important are these, and without such skills her work will amount to almost nothing.

Finally, she must have the ability to plan her work to make her time count for the most. She must be so familiar with the operation of each of her duties that she can make them fit together in an efficient and workable schedule. She must be able to carry out her plan so effectively that her own strength and energy are not depleted.

#### THOSE WHO OFFER THEIR SERVICES AS PUBLIC HEALTH NURSES

Having reviewed the qualifications which we would look for, from the three points of view, let us now study the different groups who are applying for positions in public health nursing. Firstly we have those who have neither experience in, nor special preparation for public health nursing; secondly, those who have had one or more years of practical experience under supervision but no theoretical training; and lastly, those who have taken a course in public health nursing at one of our universities. Let us briefly examine the qualifications of each of these groups to see how they conform to the requirements as we have outlined them.

##### *The Nurse without Experience or Training*

What should be expected of the nurse who has neither experience nor special preparation? It is obvious that unless she has graduated from one of

the larger hospitals within very recent years, she has not been taught any of the things which we have listed under essential knowledge. It is often stated that persons lacking in experience in public health nursing and without post-graduate training but possessed of common sense, can do an excellent piece of work. To disagree entirely with this statement would be to discount the splendid pioneer work that has been done all over the continent by women who organized and developed public health nursing services years before there were any courses available. It is a significant fact, however, that the majority of these women have gone or are going to the universities to supplement their store of knowledge. To-day it is only the exceptional nurse who succeeds in carrying out a well organized program without previous preparation. Sometimes, where trained or experienced nurses are not available, it is necessary to include nurses of this group on the staff of public health organizations. They should receive adequate supervision and definitely understand that the tenure of their position depends upon their willingness to proceed toward the completion of the public health nursing course in one of our universities as soon as possible. The exceptional nurse to whom we have just referred is the first one to seek further training as soon as an opportunity is provided. With all the more desirable nurses eliminated by their own insistence on adequate post-graduate preparation before appointment, we have left only those who may be moderately interested in public health nursing but whose personalities do not necessarily indicate that they would be successful in this work. Very careful selection must be made from this group and, for the good of the service as a whole, the requirements for employment should not be lowered to permit those who are not suitable to secure positions.

#### *The Nurse with Experience but No Training*

What can we expect of the nurse who has held a position as a staff nurse under adequate supervision with some public health organization? The success of her work will demonstrate the type of personality that she possesses, and while she has not had as much of the theory of preventive medicine, sociology, and psychology as she needs, from the practical standpoint she has learned how to handle people. This nurse should be encouraged to procure theoretical training whether she is remaining in her original organization or seeking a position in new circles. Bursaries, scholarships, leaves of absence, and special courses which can be arranged to fit into their vacation periods will help this group to equip themselves more adequately to assume positions of responsibility. The movement in Canada to-day is toward the provision of larger opportunities for these nurses to secure more complete training.

#### *The Nurse with Special Training in Public Health*

We now come to the third group, the students who come out of our post-graduate courses each year, the group that is best fitted, from the theoretical standpoint, to handle the work. It is frequently said, and there is considerable truth in the statement, that the young graduate nurse with no background of experience beyond her work in a training school is not so well equipped to handle a single nurse district, for instance, as someone who has learned through

experience. The young graduate is so full of theory and advanced ideas that she is not content to begin at the beginning and go slowly. Perhaps more experience in meeting people and in handling large groups of them before taking her post-graduate course would be an advantage. Perhaps the solution to this problem lies in the expansion of the field experience which is included in the available university courses. However, I am sure there is not one of us who does not believe—indeed, has not been convinced by her own experience—that, other things being equal, the nurse who has had a post-graduate course has a great advantage over the one who has not. And, correspondingly, has a much greater chance of success. You will observe that I say “other things being equal”, for no post-graduate course can give character or common sense or personality; and if these are lacking no amount of education can compensate for their absence.

#### REQUIREMENTS FOR EMPLOYMENT

Let us review briefly the points which we considered in each phase of our tri-section. Under personal qualifications we would require that the nurse suggest her topic of health by her own personal appearance; that she should have a desire to teach; that she should definitely like to work with people; that she should be enthusiastic, co-operative, equipped with common sense and good judgment, and have a vision of what is before her. From the second of our tri-sections, we see that she should have a thorough grounding in the essentials of public health. Finally, we have seen that she should be able to take a broad view of the family as a unit of society and be able to impart to them an enthusiasm for the service which she represents. Of the groups who are applying for positions, I believe that the nurse who has been thoroughly grounded in all of the principles which I have outlined for you is the one best fitted to meet the requirements for employment. We would be wise to insist that adequate supervision be provided, supervision of an educational nature so that, as the nurse gains in experience, she will realize that education is a continuous process. If we honestly believe that post-graduate education is essential in order to measure up to the “requirements for employment”, we should keep in mind the whole picture of the work the nurse is to do and encourage, by our own enthusiasm for it, those nurses who demonstrate the greatest aptitude both from the point of view of their personal qualifications and their interest in the work, to fit themselves to become first-class public health nurses. Talking about it is not enough. We must make our belief a living, practical thing by our continued support of courses arranged to provide post-graduate training. I have just one thing to say in closing. When we consider the situation honestly, I believe we are all agreed that experience proves that, with very few exceptions, the only nurse who makes good on the job is the experienced or trained worker. We have compromised from necessity over and over again only to find that half-way measures do not meet the need. Having evolved a set of standards which will serve as the requirements for employment, it is up to each one of us, whether we are in executive positions or are simply staff nurses, to see that nothing is done that will lower these standards.

# Registration of Vital Statistics in British Columbia\*

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THE intrinsic worth of vital statistics depends entirely on the completeness and accuracy of registration. Any deficiency either in the number or quality of registrations must of necessity detract from the value of the statistics. Failure to collect all registrations of all births that occur in any community in any given period of time results in inability to determine with accuracy the birth or infant mortality rate of that community for that period, and no reliable information can be gleaned as to the incidence of disease if certificates of death are faulty or lacking in data.

For several years past British Columbia according to official reports published has enjoyed the unenviable reputation of having not only a lower birth rate than any other Province in the Dominion, but also one of the lowest birth rates in the world. It is not possible in this paper to enter fully into all the various reasons—some conjectural—which may account for a low birth rate, but it may, I think, be assumed, at any rate in the case of British Columbia, that one of the main reasons is deficiency in registration.

As proof that deficiency in registration exists in British Columbia let me submit the following. During the year 1933 provision was made in the Vital Statistics Act whereby all teachers in all Public and High schools in the Province were required to make a return giving the names, dates, and places of birth, together with names and addresses of parents or guardians, of all pupils in attendance at their respective schools. Subsequently a return had to be made each term of all children entering school for the first time. During 1933-34 reports were received from 999 schools and 3,207 teachers. The number of pupils reported was 101,516 and of these 72,841 were born in British Columbia. Of the 72,841 born in British Columbia nearly 84 per cent were found to have been duly registered, leaving a balance of 16 per cent unregistered. A further check somewhat reduced this 16 per cent unregistered. Those parents or guardians who had neglected to register were notified, particular stress being laid on the inconveniences and vexatious delays which might befall their children owing to inability to produce certificates of birth when called upon to do so. As a result, not only were many delayed registrations of births effected of children in attendance at the schools but in many cases applications were made for registrations of birth of other members of the family. In the case of one family, living at an isolated spot on Van-

\*Chairman's address to the Vital Statistics Section presented at the Twenty-fifth Annual Meeting of the Canadian Public Health Association, Vancouver, B.C., June, 1936.

couver Island, our enquiry led to the proper registration of birth of no fewer than 14 children.

It was possible to gather from these returns that neglect to register was not confined to any one race or creed, and further to learn the various pretexts for failure to register. Here let me cite what would appear to be further definite evidence of deficiency in registration. According to the 1921 census the female Russian population of British Columbia was 3,302, and the total number of Russian births registered in that year was only 35. In Ontario, however, with a female Russian population approximately 800 less than in British Columbia, 296 Russian births were registered. Similarly in the year 1931 the census showed that British Columbia had a Russian female population of 4,819, and only 73 births, while Ontario, with approximately 1,200 Russian females less than British Columbia, had 302 births of Russian children. Considerable difficulty has been experienced in British Columbia in endeavouring to persuade the Doukhobors to comply with the law in regard to registration—a difficulty which we hope to overcome in the very near future. If further proof of deficiency in registration were required it would be supplied by the fact that in a very large number of cases where application is made for certificates of birth no certificate can be issued owing to non-registration.

Turning for a moment to delayed registrations, reference to our files shows that during the decade 1923-1932 the total number of births recorded, excluding Indians born on the Indian Reserves, was 112,878. Of this total only 100,941 were forwarded to Ottawa and included in the Annual Reports, the balance, 11,937, being lost to the Province. The inclusion of Indians would increase this loss very considerably. As an illustration of the effect on racial origin take the case of Japanese. During the ten-year period 1923-1932 the total number of Japanese registrations of births was 12,128, while the Annual Reports for these years show only 7,563 births, a difference of 4,565. It is, of course, more than likely that a considerable number of these delayed registrations were registrations of births that occurred prior to this ten-year period, but on the other hand there is little doubt that a considerable number occurred in the period, and the fact that these were not included must have had some effect as far as actual births that occurred. A somewhat striking illustration of the possible effect which delayed registrations may have on birth and infant mortality rates is to be found in the following extract, taken from a paper issued in April, 1927, by Henry F. Vaughan, Director of Public Health, Chicago:

"Notwithstanding the fact that the Chicago health authorities have been making strong efforts to secure prompt returning of births, the proportion of delayed returns continues to be very high, and the delays refer back in considerable proportion as far as 1916. For instance since 1919 as much as 20.7 per cent 'delayed' reports have been added to the original total of that year. That it is necessary to revise totals year by year over a considerable period of time, if anything approximating correct birth and infant mortality rates are to be had, is obvious. In Chicago original birth rates have been

increased as much as three and one half points, and original infant mortality rates decreased more than 23 points for a single year."

It is apparent that the Dominion Bureau of Statistics cannot in any way be held accountable for any loss occasioned to the Province either by deficiency or delay in registration; the responsibility for collection of returns rests entirely with the Province itself. The Dominion Bureau, however, is interested to this extent; namely, that any deficiency in the collection of returns on the part of any Province must affect the statistics of the Dominion as a whole.

Having shown that deficiencies and delays in registration occur in British Columbia it naturally may be asked to what causes can these delays and deficiencies be attributed. That British Columbia should experience great difficulty in regard to the collection of its vital statistics is hardly a matter for surprise when we take into consideration some of the handicaps under which the Province has laboured ever since the inception of the Act: the vast area of the Province, more than 3 times the area of the British Isles; the mountainous nature of the country, rendering transportation and communication difficult; and the sparseness of the population,—barely 2 persons to the square mile.

There is, however, one factor which more than any other has contributed to deficient registration in British Columbia, a deficiency which on many occasions has been cited by those charged with the administration of the Act, but which unfortunately still persists. I refer to inadequate facilities for registration. As long ago as the year 1879, Mr. H. B. W. Aikman, the first Registrar-General for British Columbia, wrote as follows:

"However useful the Act may be for the purpose of recording and perpetuating evidence of births, deaths, and marriages, it will not for many years to come be of any real value as a medium for the collection of vital statistics—at least no material improvement in the returns may be expected until the means for registration are brought within easy access of every family in the Province. I have in five successive reports drawn attention to the difficulties with which our system has had to contend, and the necessity for granting greatly increased facilities for registration—but without any apparent result."

An interesting comparison may be made between Alberta and British Columbia in regard to the number of collectors of returns. In the year 1906 the two Provinces had the same number, viz., 14. In the year 1908 Alberta had 412 and in 1911, 705, while British Columbia still had only 14. In 1924 Alberta had 750, British Columbia 76. At the present time British Columbia has 131, of whom 18 are for Indian Reserves only. In connection with the foregoing it must be remembered that the area of Alberta is approximately 100,000 square miles less than British Columbia and the facilities for transportation and communication are greater.

Time does not admit of going fully into the various measures which might be adopted to remedy deficiencies in registration. Mention, however, might be made of one which undoubtedly would bring results; namely, that

every child on first entering school be compelled to produce a certificate of birth. This would not only save the child from the consequences of ignorance or neglect on the part of its parents, but would further ensure correct and useful information for the teachers in the schools.

The collection of registrations of deaths and marriages calls for little comment inasmuch as during recent years they have been almost 100 per cent complete.

Despite failure in the past to reach the desired standard in registration, British Columbia has no reason to despair. Much progress has been made in the past few years and the public is being more and more educated to the need for vital statistics and the importance and value of proper registration. Persistent perseverance together with increasing co-operation on the part of the public in general will win out in the long run.

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## The Modern Conception of District Health Administration

THE modern conception of district health administration in a city visualizes a community agency engaged primarily in preventive medicine and public health education, centering in an organization of physicians, nurses, and other health and social workers, and sometimes volunteers. This district unit aims to reach all people within a district who need the services, and to co-ordinate the health, and sometimes the medical, recreation, and social service activities. The district headquarters is sometimes called

a major health centre, in contrast with the so-called minor health centre, which may be a well-child health conference or a small district office for one or more specialized health services. In either case the program is designed to supplement the services of private physicians.—Ira V. Hiscock: *District Health Administration, A Study of Organization and Planning*. Published for the Milbank Memorial Fund by the Science Press Printing Company, Lancaster, Pa., 1936.

# A Study of Foetal Mortality in Ontario\*

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THE full extent of the annual loss to our child population by foetal death is not known, but that to which we attach the term "stillbirth" is certainly great. This mortality is of considerable significance not only of itself but because it represents also a loss in the energy of motherhood and a definite degree of maternal morbidity (1). The problem of foetal death is the more important because the causative factors involved are intimately related to those which play a large part in neonatal death and particularly in the death of infants during the first week of life. The extent of this mortality may be illustrated by the fact that in Ontario, 1933, the year to which the data used in this study relate, the combined rate for stillbirths and neonatal deaths was 68 per thousand live births. Assuming conservatively that one-sixth of all pregnancies terminate in abortion, one in every 19 pregnancies resulted either in stillbirth or a neonatal death and one in 30 viable pregnancies in a stillbirth.

Of fundamental importance in respect to the problem of foetal mortality is an accurate knowledge of incidence and causation. In 1931 an attempt was made to secure more reliable national statistics of viable foetal deaths by defining a stillbirth as death of a foetus after 28 weeks or  $6\frac{1}{2}$  months of pregnancy, measuring not less than 35 cm. in length. This definition makes it clear that the term "stillbirth", unless accompanied by an accurate statement as to the period of gestation at death and the length of the foetus at birth, obviously can have no true scientific meaning and records of foetal death which do not include these are of little value.

The excellent work which has been done in England in this field by Eardley Holland and his co-workers (2) (3) is most illuminating, and it has been indicated that probably 50 per cent of foetal deaths could be prevented by proper antenatal care and improved obstetrical practice in treating the complications of childbirth. The more recent investigations conducted by the Health Organization of the League of Nations into the causes and prevention of stillbirth (4) have indicated that there is here a fruitful field for scientific study and have lent further support to the idea that many foetal deaths can be prevented.

From these preliminary considerations, it seemed desirable that a study of foetal deaths in Canada, within the limitations of the present facilities, be conducted in order to collect clinical, pathological, and statistical information which would serve as a sound basis on which to formulate a practical list of causes of such deaths, and which would provide the necessary information for the discussion of a foetal death certificate, suitable for national use.

\*Presented before the Section of Vital Statistics and Epidemiology at the Twenty-fifth Annual Meeting of the Canadian Public Health Association, Vancouver, B.C., June, 1936.

### THE PRESENT STUDY

The Public Hospitals Act of Ontario, 1931, provides that a special return shall be made of all infant deaths occurring in a public hospital, resulting directly or indirectly from pregnancy. Of the returns for 1933, 1,070 dealt with "stillbirths" and deaths of foetuses before the period of viability (28 weeks) and upon these data this study of foetal deaths was based.

#### *Completeness of the Data*

In Ontario, 1933, 2,058 stillbirths were registered. The official returns available included, according to the accepted definition, 977 stillbirths. During this year, 26,300 or 41.3 per cent of all live births occurred in institutions. Presuming that the same proportion of stillbirths would occur in hospitals, there would have been 850 stillbirths. This estimate is lower than the actual returns because stillbirths are more likely to occur in hospital since difficult and complicated cases are more frequently delivered there. Thus, of 217 maternal deaths in Ontario, 1933, in which a live or stillborn infant was delivered, 129 occurred in hospital and 88 at home. Of the former group, in 45 cases, or 35 per cent, there was a stillbirth, while of the latter in only 22, or 26 per cent, was the infant stillborn. It seems probable that the group of hospital returns of deaths of foetuses reaching the viable period, on which this study is based, must be fairly complete.

#### *Fundamental Considerations*

What do we understand by a foetus, and what do we mean by foetal death? In the words of Eardley Holland, "the transition from foetus to infant is a metamorphosis punctuated by the establishment of pulmonary respiration." On the other hand, a foetus dies when the cardiac mechanism ceases to function and in view of this, information as to the time at which this event occurs, irrespective of the time of delivery, is important though usually unobtainable accurately.

Foetal death may occur (a) before labour, (b) during labour, or (c) after labour but before pulmonary respiration is established. There are two broad classes of foetuses: (a) viable and (b) non-viable. In the former class are those foetuses which reach the conventional period of viability— $6\frac{1}{2}$  months or 28 weeks. These are commonly referred to as "stillbirths". A viable foetal death occurs, then, when a foetus is born after 28 weeks of pregnancy, and when pulmonary respiration does not occur. This is actually the definition of "stillbirth" proposed by a special Committee of the League of Nations in 1925.

#### *Classification of Foetal Deaths by Cause*

In an approach to measures designed to reduce the incidence of ante- and intranatal death, knowledge of the causes thereof is a first requisite. In the present study, major interest was therefore attached to causes of death and in general what was desired was the underlying morbid clinical state of foetus, placenta, or mother, responsible for death, i.e., "the disease which initiated the train of events leading to death." To know that a foetus died of cerebral haemorrhage is of some specific value but from the viewpoint of preventive obstetrics it is important that the clinical state which gave rise to such injury be known—placenta praevia, contracted pelvis, malpresentation, etc.

The plan of classification adopted was essentially that devised by Eardley Holland (2) in 1922 and subsequently expanded by Holland and Lane-Claypon (3) in 1926, and is clinico-pathologic in nature. Those cases in which the data did not permit specific assignment are classified as "inadequate data". It is planned to present full details of a proposed scheme for the classification of causes of foetal death in a subsequent paper. Table I gives the major groups in this scheme.

TABLE I  
NOMENCLATURE OF CAUSES OF FOETAL  
DEATH  
Major Divisions

Major Divisions
1 Complications of labour
2 Antepartum haemorrhage
3 Toxaemias of pregnancy
4 Syphilis
5 Placental states
6 Foetal states
7 Maternal diseases
8 Prematurity
9 Cause unknown or undetermined
10 Inadequate data

in vital statistics was adhered to—i.e., the morbid state selected as cause of death was that which might be termed the primary or underlying clinical condition or pathological state of foetus and placenta; the one to which, with a considerable degree of certainty, one might assign "the responsibility for the train of events leading to death."

Foetal death was attributed to prematurity only when there was no evidence of the cause of such prematurity. In a number of cases, data on the forms were insufficient to permit classification of the death. These were grouped under "inadequate data". Deaths of foetuses under the age of 28 weeks were classed as non-viable cases and sub-classified according to the scheme adopted for viable foetuses as given above.

In all, 1,070 foetal deaths (as distinct from infant deaths) were included in this study. Those of less than 6½ months' gestation, termed non-viable cases, numbered 93, and the remainder, or viable cases, 977.

#### *Examples of Selection of Cause of Death for Tabulation*

The following examples illustrate the principles of selection employed in tabulating the deaths by cause.

Case no. 206. Asphyxia from prolonged breech labour, with contracted pelvis. Foetus stated to have sustained injury at birth.

This foetal death was attributed to contracted pelvis as the clinical condition responsible for the train of events—prolonged labour, birth injury, and asphyxia—which led to death, and the death was classed under 1, *Complications of labour*.

Case no. 178. Intrauterine asphyxia due to separation of placenta, due to placenta praevia.

Here the placenta praevia is the gross clinical condition responsible for the foetal death, and the case was assigned to 2, *Antepartum haemorrhage*.

In each of the major divisions in the list sub-titles have been provided, the number of which varies from group to group. Complications of labour, for example, includes cord complications, contracted pelvis, abnormal presentation, difficult labour, excessive size of foetus, etc.

In assigning a particular case to a given cause or cause-group, the general principle governing all such practice

### *Reliability of the Data*

It must be pointed out before proceeding that in only relatively few instances was an autopsy performed and that therefore certain statements, the presence or absence of birth injury, for example, are to be accepted with reservation. The number of deaths classed to syphilis, too, might be expected to be considerably underestimated by such data as these. Many of the cases in which cause of death was stated as unknown, and a number of deaths classed to prematurity, may probably have been syphilitic in origin. The records in respect of gross clinical and pathologic states, however, may reasonably be accepted with some degree of confidence. The group studied is fairly large and is drawn from public hospitals throughout the province where opportunity for an accurate diagnosis may be presumed to have been better than in the province at large.

The fact that the group of deaths under study are hospital cases also deserves some comment. Although the sample is fairly large and is drawn from various parts of Ontario, the data can by no means be conceived to be a random sample of obstetric experience in the province. As a cross-section of hospital experience, the material may be accepted, but any facts which are brought out by this study may not be presumed necessarily to apply to the province as a whole. Confinements in hospital are a selected group and include many of those considered likely to be difficult, as well as a large body of frankly complicated cases. If these points are clearly kept in mind, this study, within the limitations outlined, may reveal many facts of practical interest concerning foetal mortality.

### *The Causes of Death in Viable Foetuses*

The causes of foetal death as determined for viable foetuses are given in table II.

The cases grouped as "insufficient information" and as "non-viable cases" have been excluded in computing the percentages in order to permit more accurate comparison of the first nine classes among themselves and with similar data published by other observers.

The principal causes of death are complications of labour, antepartum haemorrhage and toxæmias of pregnancy, and these are also leading causes of maternal deaths. It is in these groups and syphilis particularly in which measures of prevention and control would be expected to be most effective.

Two of the most striking features of this table are the high proportion of foetal malformations and the low proportion attributed to syphilis. The unusually high proportion of foetal malformations gives strong support to a contention that this sample cannot be considered a random one and that any deductions made from this study can be presumed to apply only to the particular group from which the sample has been drawn. The decisive excess in this group suggests that the sample itself is a selected hospital sample rather than a random one, and that great care must be exercised in considering the

TABLE II  
THE CAUSES OF FOETAL DEATH  
Ontario Hospital Returns, 1933

Cause of death	Number	Per cent*
1 Complications of labour...	296	34.9
2 Antepartum haemorrhage...	118	13.9
3 Toxaemias of pregnancy...	119	14.0
4 Syphilis.....	16	1.9
5 Placental states.....	11	1.3
6 Foetal states.....	160	18.9
7 Maternal diseases.....	52	6.1
8 Prematurity.....	22	2.6
9 Cause unknown or undetermined.....	53	6.3
10 Inadequate data.....	130	...
<i>Non-viable cases</i> .....	93	...
Total.....	1,070	100.0

\*Excluding non-viable cases and those in which data were inadequate.

data. It is probable, too, that these data do not give a true picture of the mortality among viable foetuses from syphilis. Factors responsible for this discrepancy may be (1) that no specific data regarding syphilis or the Wassermann test were sought on the enquiry form employed, and (2) that many of the foetal deaths due to syphilis were not so diagnosed and are recorded as "cause unknown or undetermined" or as those grouped under "inadequate data".

#### *Previous Work in this Field*

A substantial amount of work has been done in this field by investigators in other countries and some of these data are given in table III for comparison (2, 5, 6).

TABLE III  
FOETAL MORTALITY BY CAUSE  
Various Investigators

Cause of Death	Holt-Babbitt New York	McQuarrie San Francisco	Holland London	Present Study
Complications of labour.....	38.9	37.1	28.3	34.9
Antepartum haemorrhage.....	11.0	2.1	22.3	13.9
Toxaemia of pregnancy.....	14.7	9.3	8.6	14.0
Syphilis.....	9.3	15.5	15.3	1.9
Others*.....	.....	5.2	8.6	7.4
Foetal states.....	1.6	8.2	5.6	18.9
Prematurity.....	4.2	5.2	0.3	2.6
Cause unknown.....	20.3	17.4	10.7	6.3
All causes.....	100.0	100.0	100.0	100.0

\*Including placental states and "various".

The limitations attending comparison of data such as the above should be emphasized. Some of the sources of these limitations are as follows: (1) the procedures employed in investigating the cases were not in each case the same; (2) the populations from which the data are drawn are not the same; (3) the classification of causes of foetal death employed by the various workers is different; (4) the group selected for investigation is not rigidly defined in each case—some groups include foetuses which have lived a few hours after birth (some include deaths up to two weeks after delivery), while in some instances the precise constitution is not quite clear; (5) some of the investigations are undertaken in one hospital centre or one city, and in others the data have been collected from a wider area; and finally (6) discrepancy in allocating the cases by cause of death is bound to occur in doubtful cases at least and there is little doubt that unless the practice followed in the selection of the "cause of death" for tabulation is explicitly defined, considerable variation may be traced to this factor alone. However, with the exception of deaths attributed to syphilis and to foetal malformations, there are broad resemblances in the data from the several sources included in the above table.

#### *Presentation of Foetus*

Pinard has observed that the proportion of breech presentations in a large group of viable pregnancies was 3.3 per cent. McQuarrie (6) in a group of 119 foetal deaths found over 25 per cent in the class. It is a well-known fact that breech deliveries and all presentations other than occiput anterior are more

difficult and involve increased risk to life and health of both mother and foetus, so that "abnormal" presentations are a predisposing factor toward foetal and infant death. The special inquiry form employed in Ontario asks for "type of presentation." In many instances the reply given was merely "vertex", or "occiput". Table IV provides a short résumé of the data on type of presentation.

Excluding the non-viable cases and those not stated, 17.9 per cent were breech presentations and 12.8 per cent occiput posterior. Including brow, face, transverse, breech and occiput posterior cases as "abnormal", 38 per cent were in this category. Brow, face, and transverse presentation formed 7.3 per cent of the total. Of deaths attributed to toxæmia of pregnancy, 31 per cent of the presentations were "abnormal", while of those classed to complications of labour the proportion was much higher, viz. 57 per cent, by reason of the nature of the group.

#### *The Use of Instruments in Delivery of the Foetus*

On the inquiry form, data concerning the use of instruments were specifically sought by the query, "Were instruments used?" Frequently further information was given on this point elsewhere on the form.

Of all cases, excluding non-viable foetuses and those in which no information was available, instruments were used in 29.3 per cent. If operative cases (Caesarean section) be included, the percentage is 32.8. In Woodbury's study (7) of 813 stillbirths in eight cities in the United States, the proportion was approximately 20 per cent and "the proportion of stillbirths among the cases of instrumental delivery (which included about 1 in every 15 births) was very high—12.2 per cent, or over four times the percentage of stillbirths among normal deliveries, 2.8. In fact, 104 stillbirths were delivered with the aid of instruments as compared with only 23.8 which would have been expected if the rate for normal deliveries had prevailed (Baltimore data only)."

These two facts—(1) a high proportion of "stillbirths" among cases of instrumental delivery, and (2) a high proportion of instrumental deliveries among "stillbirths"—support the contention that instrumentation, though perhaps not always the primary factor in foetal death in these cases, nevertheless is an important consequent event contributing measurably to the pregnancy wastage represented by foetal mortality.

#### *Type of Delivery*

An attempt was made to classify the cases broadly according to type of delivery. It was often found that delivery was not specified as spontaneous in so many words but it was apparent that such must have been, or was at any rate probably, the case. These latter were classified as spontaneous, thus, if

TABLE IV  
PRESENTATION OF FOETUS\*  
Ontario Hospital Returns, 1933

	Number	Per cent
Occiput anterior . . . . .	275	29.9
Occiput posterior . . . . .	118	12.8
Brow or face . . . . .	33	3.6
Other cephalic . . . . .	296	32.1
Breech . . . . .	165	17.9
Transverse . . . . .	34	3.7
Not stated . . . . .	56	....
Total . . . . .	977	100.0

\*Excluding non-viable cases.

anything, weighting this group somewhat favourably. Various combinations of obstetrical procedure were reported as: instruments and version, instruments and Caesarean section; and instruments were specified in several instances in which labour was induced. The cases were classified in five groups: spontaneous, induced, instrumental, version, and operative (Caesarean section). Version, induced, and operative cases include all those so specified, regardless of the use of instruments, so that the "instrumental" group includes only those cases where no other procedure—version, or Caesarean section, was specified. A short summary of the data is given in table V.

TABLE V.  
FOETAL DEATHS BY TYPE OF DELIVERY\*  
Ontario Hospital Returns, 1933

Type of delivery	Number	Per cent Total
Spontaneous.....	566	58.5
Induced.....	39	4.0
Instrumental.....	252	26.1
Operative.....	34	3.5
Version.....	77	8.0
Not stated.....	9	...
Total.....	977	100.0

\*Excluding the non-viable cases.

latter group excludes 32 instances in which instruments were employed with other procedures, viz. 26 instances of version plus instruments and 6 cases of induced labour followed by instruments. In 41.5 per cent of all cases the delivery was non-spontaneous.

#### *Injury at Birth*

On the inquiry form the question was asked: "Was injury at birth cause of death or contributory thereto?" In 10 per cent of cases no reply was given to this question. In all, there were only 88 instances in which injury at birth was said to have been a factor in the death. This is 9.9 per cent of the total (excluding the non-stated and non-viable cases). Of those deaths attributed to complications of labour in 75 cases, or 28.4 per cent, birth injury was specified. This is striking.

These returns are undoubtedly an understatement of fact. In probably very few cases was an autopsy performed and one cannot therefore expect to obtain conclusive data. In Ontario, 1933, for example, 279 infant deaths were ascribed to birth injury—a rate of 4.4 per 1,000 live births. In his report on the factors determining death in a sample of 300 viable foetuses, Eardley Holland (2) found that "of 167 fresh foetuses, i.e., those which died during labour, no less than 48 per cent had tearing of the septa of the dura mater and cerebral haemorrhage. In breech cases the proportion

TABLE VI  
INCIDENCE OF TEARS (PER CENT) IN 526  
FOETAL DEATHS\*  
by Type of Presentation (after Holland &  
Lane-Claypon)

Presentation	Cause of Death	
	Complications of Labour	Other Causes
Vertex anterior.....	34.8	18.5
Breech.....	58.5	36.0
V.O.P.....	51.5	(25.0)
Transverse.....	39.3	14.3
Face.....	(50.0)	0
All types.....	42.2	19.6

\*Fresh foetuses only.

of tears was 75 per cent." Holland's findings and the fact that 18 per cent of the viable foetuses in this study were delivered by the breech (excluding those cases in which no data on this point were available) support the contention that the proportion of cases in which injury at birth occurred is definitely understated.

The study made by Holland and Lane-Claypon (3) demonstrated in striking fashion the incidence of tentorial tears in foetuses delivered in various presentations. These data are summarized in table VI.

When all cases are included, these workers found tentorial tears in 19.9 per cent of vertex anterior presentations and in 26.3 of all presentations.

These facts serve to emphasize the importance of birth injury in foetal and infant deaths.

#### *Age of Foetus*

The replies to the questions, "Was child full term?" and "If not, state degree of prematurity" provided the data on period of gestation. What was recorded was in effect the period of gestation at death.

Table VII gives a summary of the cases by period of gestation and cause of death.

Excluding the cases in which no data on this point were available (25), only 56.3 per cent of the foetuses reached term. Classifying all foetuses born at or before 8 months as "premature," 39.3 per cent were "premature." As was to be expected, considering the nature of the group, only 16 per cent of foetal deaths attributed to complications of labour were "premature." The classes showing excess of premature foetuses were antepartum haemorrhage 55 per cent, puerperal toxæmias 64 per cent, and maternal disease 61 per cent. The percentage distribution of the cases by month of gestation shows rather significantly higher proportions reported as 7 or 8 months than at the half-month period. This doubtless reflects a tendency to report the period of gestation in "round numbers."

The solution of the problem of deaths among premature foetuses and infants depends upon the solution of the causes producing premature delivery of the foetus. To this end, a study of the "primary" causes of foetal death in relation to period of gestation at birth should be of value.

Many interesting findings were noted in relation to sex variation in foetal mortality. These data will be presented in a later article.

#### *Death of the Mother*

In earlier papers (8) (9), it has been pointed out that the death rate among

TABLE VII  
PERIOD OF GESTATION IN 1,070 FOETAL  
DEATHS  
Ontario Hospital Returns, 1933

Age of Foetus	Number	Per cent Total*
<6½ months.....	93	....
6½ ".....	57	6.0
7 ".....	122	12.8
7½ ".....	59	6.3
8 ".....	136	14.2
8½ ".....	42	4.4
Term or T+.....	536	56.3
Not stated.....	25	....
Total.....	1070	100.0

\*Excluding non-viable cases.

mothers giving stillbirths was much higher than among mothers giving live births. In the Manitoba study (8), 20 per cent of all maternal deaths were associated with a stillbirth. This is more than 6 times the proportion of stillbirths to total confinements for the period. Expressed per 1,000 stillbirths and per 1,000 live births reported, the rates were 32 and 2.2 "In other words, 15 times as high a proportion of women giving stillbirths die as do women bearing live-born children." This, of course, is a manifestation of the effects of maternal disease upon the foetus and partly due to the fact that difficult delivery, etc., which are more likely to give rise to stillborn foetuses, carry a significantly greater risk to the mother.

In this study, besides the hospital returns of foetal deaths, there were available also the hospital returns of maternal deaths. These were checked against the foetal deaths and in 39 instances it was found that a record was available for the mother who had died also.

Of the 39 maternal deaths associated with a foetal death, two were associated with foetal deaths of non-viable age, one at 5 and one at 6 months. Therefore, 37 maternal deaths occurred in a group of 977 confinements (approximately), producing "stillborn" foetuses and a maternal death rate of about 38 per 1,000 such confinements.

#### *Prenatal Care*

A section of the inquiry form provided for a statement as to the nature and extent of prenatal care which the mother received. Replies were on the whole unsatisfactory and it was difficult to interpret many of them quantitatively or qualitatively.

In 13 per cent of all viable cases no data were available. In 18.3 per cent of cases (excluding those in which no data were given) there was *no* prenatal care. This, perhaps, is the one really significant fact for these cases were delivered in hospital and are more likely to have made previous contact of some sort. In probably at least 15 per cent of cases the prenatal care could be described as inadequate.

Some further insight into this question is obtained from the data collected in reply to the query, "When did the mother first notify her physician of her pregnancy?" In 68.4 per cent of the viable foetuses the mother first saw a physician at or before 6 months' gestation. Slightly more than one-third made their first contact with the physician in the first trimester and one-third in the second. The nature of the prenatal care subsequently received by the mothers would seem to have been in general rather poorer than one would have expected in view of the early contact made by a large proportion of the mothers.

#### *Preventability of Foetal Death*

Williams (10) in his discussion of the limitations and possibilities of prenatal care, stated that by prenatal care two-thirds of foetal deaths due to syphilis could be prevented and, further, that two-thirds of foetal deaths from dystocia, one-half of those ascribed to prematurity and four-fifths of those attributed to puerperal toxæmias could be prevented by suitable prenatal care.

Holland (2) reported that of his 300 foetal deaths one-half were preventable. Of the preventable group, prevention lay in antenatal procedures in about 40 per cent, in intranatal methods in about 40 per cent, and in the remainder, combined antenatal and intranatal methods were necessary. As Holland also pointed out, it is evident that for successful preventive work in this field a closely correlated antenatal and intranatal work is necessary and in order of possible success to be attained, the promising groups were felt by Holland to be: (1) complications of labour, (2) syphilis, and (3) toxæmias of pregnancy. "Foetal mortality is not likely to fall until the standard of midwifery is raised."

#### SUMMARY

1. The wastage of life represented by foetal death deserves careful study.
2. A study of 1,070 foetal deaths in Ontario hospitals is presented and a workable nosology is employed in the classification of causes thereof.
3. Of all cases (excluding those non-viable and those classed as inadequate data) 63 per cent were attributed to complications of labour, antepartum haemorrhage and toxæmia.
4. In an unusual proportion of the cases, the presentation was "abnormal", 18 per cent, for example, being breech cases.
5. In 29 per cent instruments were used.
6. In 41.5 per cent delivery was not spontaneous.
7. Injury at birth is an important factor in foetal death.
8. Only 56.3 per cent of the viable foetuses reached term.
9. The maternal death rate was 38 per 1,000 viable foetuses.
10. Probably one-half of viable foetal deaths are preventable.
11. The data presented are derived from hospital experience only and no deduction as to the general situation in the province can be hazarded therefrom.

#### ACKNOWLEDGMENT

The writer is indebted to Dr. J. T. Phair, Chief Medical Officer and Director of the Division of Maternal Welfare and Child Hygiene of the Ontario Department of Health, for making available the returns of "infant" deaths occurring in public hospitals during the year 1933.

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**ABSTRACTS OF PAPERS**  
**PRESENTED AT THE**  
**FIFTH ANNUAL CHRISTMAS MEETING**  
**OF THE LABORATORY SECTION**

**Toronto, December 21 and 22, 1936**

1. **Immunity against Haemolytic Streptococci in the Rabbit**—DR. FRIEDA H. FRASER, *Connaught Laboratories and School of Hygiene, University of Toronto.*

A STRAIN of haemolytic streptococci belonging to Lancefield's precipitin group B was found to be virulent for rabbits. This strain is not fibrinolytic and produces no measurable exotoxin in broth culture; however, washed suspension of killed culture when injected intradermally causes raised haemorrhagic lesions which do not occur if the suspension is mixed with an equal volume of immune serum before injection. Killed suspensions of other, less virulent, strains gave similar results in proportion to their virulence; but in these the reaction was not inhibited by serum prepared against the virulent strain.

Rabbits are invariably killed by the intradermal injection of 0.1 cc. of an 18-hour broth culture of the virulent strain; a haemorrhagic lesion develops at the site of injection, blood cultures become positive in 1-3 hours and show innumerable colonies before death. A marked reduction in leucocytes and especially in polymorphonuclear cells accompanies the invasion of the blood-stream, but the haemoglobin and the number of red cells are not affected.

Active immunity and the protective effect of passive immunization appear to be proportional to the agglutinin content of the serum. Passive protection could be obtained either by mixing an equal volume of immune serum with the culture before injection or by injecting the serum intravenously. In both actively and passively immunized animals the local reaction was less, leucopenia did not occur, and blood cultures were generally negative although a few colonies per cc. of blood were sometimes found 24 hours after injection.

The intradermal injection of avirulent strains such as Dochez N.Y.5 causes only a slight local lesion, seldom yields positive blood cultures, and as a rule the leucocyte count rises, with a relative increase in polymorphonuclear cells.

The intravenous injection of either virulent or avirulent formalized washed cocci causes an immediate decrease in the leucocytes due mainly to a reduction in polymorphonuclear cells which may disappear almost completely in 2-10 minutes. The white cell count is lowest 6-10 minutes after injection and returns to normal in about 4 hours. In stained blood smears, cocci are seen within the leucocytes as early as 1 minute after injection but the average number per cell increases for at least 30 minutes. Free cocci decrease in geometric progression

from about 30 to 1 or 2 per oil immersion field during the first hour. Clumps of platelets are numerous immediately after injection and decrease to normal levels within an hour. These clumps almost all contain cocci at first but the proportion of platelets free of cocci increases until, in 15 minutes to 1 hour, none are adjacent to cocci.

Similar changes occur when the injection of virulent cocci is preceded by an intravenous dose of immune serum except that very few free cocci are seen at any time.

## 2. Pneumococcus Typing in a Public Health Diagnostic Laboratory:

**Analysis of the Incidence of the Various Types**—DR. W. B. MCCLURE, *Division of Laboratories, Department of Health of Ontario, Toronto.*

**A**N analysis is presented of 532 pneumococcus typings by the Neufeld method of sputa, pleural and spinal fluids, and other exudates, representing typing of specimens from 442 different individuals.

Of 369 sputa, 40 per cent. were from Toronto and the remainder from rural areas. Of 60 specimens of pleural pus, 92 per cent. were rural in origin.

Of sputa in 269 cases showing pneumococci, 13 per cent. were type I, 4 per cent. type II, and 8 per cent. type III. Of pleural pus in 60 cases, 62 per cent. were type I, 8 per cent. type II, and 3 per cent. type III. Seven cases of pneumococcal meningitis were all of different types. Of the group IV pneumococci, types VIII, VI, IV, V, XII and XIX were the most common types encountered, in that order. Five persons showed two different pneumococcal types in their sputa.

The rapid method of typing infection in cases where pneumococci were isolated gave positive findings in 80 per cent. of cases of type I from Toronto and in 75 per cent. from rural areas. Thirty-five per cent. of 11 cases of type II from rural districts were positive directly. In both Toronto and rural centres 45 per cent. of group IV were positive directly. Pleural and spinal fluids in which pneumococci were found present were found directly in the majority of instances.

Questionnaires were sent to 303 physicians submitting specimens for typing, 78 per cent. of which were returned. An analysis of these reports is presented, including data concerning clinical course, use of serum, and mortality.

## 3. The Correlation of Specific Sensitization, as it Occurs Clinically in Man, and as Induced Experimentally in Animals

—DR. A. H. W. CAULFIELD, *Connaught Laboratories, University of Toronto.*

**T**HE specific sensitization in man referred to in the title is hay fever due to ragweed pollen; that in animals (guinea-pigs and monkeys) is the state of anaphylaxis induced by the injection of ragweed pollen extracts.

Reference is made to a particular method of precipitating ragweed pollen extracts which on injection induce a high state of anaphylaxis in *all* animals so treated. Reference is made also to the technique and interpretation of the Prausnitz-Kustner reaction.

It is shown that the serum of guinea-pigs sensitized in the manner mentioned is capable of passively sensitizing human skin in a manner comparable to the results obtained when the serum of humans (who have hay-fever due to ragweed pollen) is used; i.e., the Prausnitz-Kustner reaction.

Comment is made upon the desirability, in view of these results, of determining if any experimental animal will give, when in the anaphylactic state, two of the essential findings of the human being sensitive to ragweed pollen, namely, a positive skin test and a positive Prausnitz-Kustner reaction.

In an initial approach to this problem it was found possible to passively sensitize the skin of the rhesus monkey with suitable sera from both man and guinea-pig. It was then shown that a positive skin test could be demonstrated in monkeys suitably sensitized and that the serum from such an animal would passively sensitize human skin sites.

Reference is made to the experimental results of anaphylaxis in the monkey by Kopeloff, Davidoff and Kopeloff.

Comment is made upon the unique position which disturbances in man, known or suspected to be allergic, occupy amongst his ailments. The conception of an allergic etiology for varied groups of symptoms in man came into being as a result of the standardization of the antitoxin content in immune sera. It was in this way that the sudden death on reinjection of guinea-pigs with horse serum was encountered and termed anaphylaxis. The proof of a common factor in induced specific sensitization in animals and in hay-fever in man has been obtained by using man as the test or experimental subject.

A biological explanation is offered to explain why:

(a) The offspring of a sensitized guinea-pig are sensitive to the excitant of the mother—as shown by anaphylactic shock on intravenous injection, and

(b) The offspring of a mother sensitive to ragweed pollen does not suffer from the same type of hay-fever—even though born during the ragweed season.

#### 4. Further Observations on Staphylococcal Infections of the Bovine Udder—DR. RONALD GWATKIN, Ontario Research Foundation, Toronto.

NINETEEN cases of mastitis in which staphylococci appeared to be the aetiological factor were found among 260 cows (7.3 per cent.).

One hundred and ninety of 275 strains of *Staphylococcus pyogenes* fermented mannitol and 85 did not. Twenty-four of the positive group were recovered from apparently normal udders (12.6 per cent.) and 60 per cent. of the negative strains were from this source.

Forty of 65 strains of staphylococci showed some degree of zone production on Stone's beef extract-gelatin-agar plates and 11 of these liquefied Stone's beef extract-gelatin. Seventeen kittens were given intraperitoneal injections of 3.0 cc. of boiled filtrates of some of these strains and 7 of them showed some gastro-intestinal symptoms, in one case very severe. Two, however, had worms in their vomitus and should probably be excluded. All the kittens injected with filtrates showed lassitude. Two of the kittens that vomited had received filtrates of strains that were negative by both gelatin tests. (These were not the 2 that had worms in the vomitus.) One of 4 kittens injected with uninocu-

lated, boiled medium manifested some pain and uneasiness for about 5 minutes but no lassitude. The other 3 showed no symptoms.

Agglutination and complement fixation tests on blood serum and whey from streptococcal and staphylococcal cases were negative. Efforts to use whey as antigen in the complement fixation test with serum from cases of known staphylococcal and streptococcal infection also failed.

There did not appear to be any difference in the opsonic activity of whey from infected and non-infected animals in the few samples tried.

Sixty-two samples of blood serum were examined for their content of staphylococcus antitoxin in terms of International Standard Units. In a group of 42 abattoir samples from heifers and young steers, only 12 per cent. had 4 units and over per cc. In a group of 14 staphylococcal mastitis cases 78.6 per cent. had 4 units and over, and 64.3 per cent. had 10 units and over as compared with 2.4 per cent. of the abattoir group.

In the examination of 32 samples of whey, one-quarter of a staphylococcal mastitis udder showed the same titre as the serum (20 units per cc.). The other 3 quarters were low.

Reference is made also to the treatment of 3 infected cows with staphylococcus toxoid.

**5. Some Histological Changes in the Rabbit's Kidney following the Injection of Staphylococcus Toxin—DR. JOHN H. GLYNN, Department of Bacteriology, McGill University, Montreal.**

THE earliest demonstrable change occurring in the kidneys of rabbits following the intravenous injection of a sub-lethal dose of staphylococcus toxin is a modification of the calibre of the blood vessels. It takes place within five minutes and is shown histologically as a dilatation of glomerular capillaries which is the result of dilatation of cortical arterioles. Associated with these vascular changes are changes in the cytoplasm of the cells of the convoluted tubules as demonstrated by alterations in the mitochondria. Later changes are haemorrhage and necrosis. Indirect evidence points to a direct action of the toxin on tubular epithelium rather than a necrosis secondary to vascular damage.

**6. *B. welchii* as an Indicator of Pollution in Sanitary Surveys—D. H. MATHESON, M.A.Sc., Chemist and Bacteriologist, Filtration Plant, Hamilton, Ontario.**

THE enumeration of anaerobic sulfite-reducing bacteria by means of Wilson and Blair's medium was undertaken in a sanitary survey of Burlington Bay, for comparison with other tests. A satisfactory correlation between *B. coli* and *B. welchii* was found. In highly polluted areas both organisms were numerous, but as the distance from the source of pollution increased, *B. coli* disappeared more rapidly than *B. welchii* due to the latter's greater resistance to unfavourable conditions. Thus *B. welchii* can be used to trace pollution farther away from its source.

The following table shows the numerical data averaged for zones of different contamination.

## BACTERIOLOGICAL AVERAGES, BURLINGTON BAY, 1936

Zone	Samples	Agar per 1 cc.	<i>B. coli</i> per 1 cc.	<i>B. welchii</i> per 10 cc.
Industrial shore.....	78	190,000	12,000	13.9
Beach shore.....	51	24,000	340	2.9
North shore.....	42	7,600	10	1.1
West end.....	30	3,800	80	4.9
Desjardin canal.....	23	730	550	7.5
Centre of Bay.....	27	24,000	24	1.6
Lake Ontario.....	72	365	1.1	.75

## 7. The Specificity of Typhoid and Paratyphoid Vaccines in Animals—

DR. M. H. BROWN, Connaught Laboratories and School of Hygiene, University of Toronto.

IN 1915 the experience of the British forces led Dryer to advocate the inclusion of *B. paratyphosus alpha* and *B. paratyphosus beta* in the monovalent typhoid vaccine previously employed in the army. Statistical data have been brought forward as evidence that the incidence of the paratyphoid fevers had been lessened by the "triple vaccine".

In 1927 the paratyphoid fraction was withheld from the vaccine used in the United States army. Based upon an analysis of the field experience with this vaccine Hawley and Simmons have asserted that monovalent typhoid vaccine confers an immunity against paratyphoid infection.

The following experiments were undertaken to test the validity of this latter contention, in so far as laboratory animals are concerned, by establishing whether or not a given monovalent vaccine afforded cross-protection against infection with living micro-organisms.

A large group of mice was vaccinated with typhoid vaccine prepared by a standard method using the rejuvenated Rawlings strain (mouse passed). One-third of this group was injected with a suspension of living, fully virulent *B. typhosus* and found to be protected. The other two-thirds were injected with living *B. paratyphosus beta* and *B. paratyphosus alpha* respectively and virtually no protection was evidenced. Similarly a group of mice was immunized with *B. paratyphosus beta* vaccine and each of one-third of these injected with living *B. typhosus*, *B. paratyphosus beta* and *B. paratyphosus alpha*, respectively. Protection was afforded against the homologous strain only, namely *B. paratyphosus beta*, and not against the heterologous strains, *B. typhosus* and *B. paratyphosus alpha*. This experiment was repeated using similarly *B. paratyphosus alpha* vaccine and protection against the homologous strain only was obtained. From these observations on groups of mice it appears that the immunity conferred by vaccination against typhoid and against paratyphoid infections is specific.

## 8. Cultivation or Direct Smear in the Diagnosis of Gonococcus Infections?—DR. J. E. JOSEPHSON, Toronto General Hospital.

A STUDY was made of 1,031 urethral and cervical swabs from clinical cases, suspected cases, and treated cases of gonorrhoea, to determine the value of the cultural method as opposed to direct smear in the diagnosis. Of 312

specimens positive by either or both methods, it was found that in 74 the direct smear was negative while the cultures were positive, in contrast to 13 instances in which the smear was positive while the culture was negative. According to sex the value of the cultural method was far more marked in the specimens from females, for while in males the direct smears were negative in 23 of 227 positive specimens, in females 51 out of 85 positive specimens would have been negative had smears only been examined.

**9. A Case of *B. morgani* Pyelitis admitted as Tuberculosis of the Kidney**

—DR. D. A. MACLULICH, *Bacteriologist, Department of Pathology, Mountain Sanatorium, Hamilton, Ontario.*

PREVIOUS to admission acid-fast bacilli were reported as having been found in the urine on a number of occasions and autopsy of a guinea-pig inoculated with the urine showed generalized lesions thought to be tuberculous but no acid-fast bacilli were demonstrated. Since admission 3 guinea-pigs have been inoculated but negative intracutaneous tuberculin tests have been obtained. Catheter specimens of urine have yielded a pure growth of a non-lactose-fermenting, gram negative bacillus which has been identified as *B. morgani*.

**10. Control of Rancidity, Slight Rancidity, and Other Defects in Ontario Cheddar Cheese**—DONALD B. SHUTT, B.S.A., *Department of Bacteriology, Ontario Agricultural College, Guelph.*

AS the result of an investigation by the writer during the years 1930, 1931, 1932, and again in 1936 it has been proved, chiefly by circumstantial evidence, that rancid, slightly rancid, fruity and some other flavours and defects in cheese can be controlled by efficient sterilization of utensils and proper pasteurization of whey returned in cans to the farms.

Definite identification of the types of micro-organisms concerned has not been completed, but the evidence points to yeasts as being the cause of fruity flavours. A combination of bacteria, chiefly a coccus occurring in large clusters in milk, appears to be associated with rancid flavours. The source of the yeasts has been found to be recontaminated whey or unpasteurized whey returned to the farmers in their milk cans. Efficient pasteurization, or boiling of the whey, has eliminated all fruity outbreaks under observation.

The source of the bacteria associated with rancidity has been traced chiefly to non-sterile milk cans. Rusty and defective cans were the worst offenders. Many severe and long standing outbreaks of rancidity were brought under immediate control by the elimination of defective cans and by efficient washing and sterilization of cans.

As the result of this investigation, reports from many reliable sources indicate a great improvement in the quality of the cheese made since 1931. With so many factories in operation, complete elimination of these defects can hardly be expected.

**11. The Agglutination of Salmonella and Dysentery Bacterial Suspensions by Control Sera from Individuals in the City of Montreal—**

J. M. DESRANLEAU, L. P. LEBEAU, and M. H. McCRADY, *Division of Laboratories, Ministry of Health, Quebec.*

**G**ROUPS of from 100 to 200 control sera and a group of 58 sera from patients, the great majority of whom were cases of non-enteric febrile disease, were examined with respect to their ability to agglutinate various *Salmonella*, *Dysentery* and *Brucella* suspensions. Seven *Salmonella*, 1 *Brucella* and 7 *Dysentery* suspensions were employed in the tests.

The more important features of the results obtained are:—the similarity between the Flexner dysentery titres of the control sera and those of the non-enteric fever sera; the similar incidence of Flexner dysentery agglutinins in the male and the female sera; the usual discrepancy between the *S. typhi* "H" titres of male sera and those of female sera; a curious discrepancy between the *S. aertrycke* "H" titres of the male sera and those of the female sera; the comparatively wide distribution of the Flexner "X" and "Y" agglutinins; and the infrequent occurrence of moderate titres of agglutinins for *Br. abortus*, *S. paratyphi* "C" and for *B. dysenteriae Sonne*, in the sera examined.

**12. An Investigation of the Source of Arsenic in a Well Water—DR. J. WYLLIE, Professor of Preventive Medicine, Queen's University, Kingston, Ontario.**

**S**EVERAL cases of arsenical poisoning occurred on a farm near Madoc, Ontario, between 1927 and 1935 and all are attributable to drinking water from a well. The well was drilled to a depth of 94 feet through "red rock" in 1922 by the owner of the farm which was sold to a young man, who, with his newly wedded wife, assumed occupancy in 1927.

In August, 1932, the young farmer exhibited signs of chronic arsenic poisoning but was diagnosed as a case of chronic nephritis and died in October 1932. His wife lost three full-time babies shortly after birth from no apparent cause between 1928 and 1932; and in April 1935 she was referred on account of a cardiac condition to a consultant who diagnosed chronic arsenic poisoning.

The deceased's brother took over the farm in October, 1932, his sister-in-law remaining on the farm as his house-keeper. He had consulted his local physician on several occasions during 1934 and in the spring of 1935 he entered hospital for observation. X-ray plates of his stomach and gall-bladder were taken but no abnormality was discovered. Still complaining of weakness, gastrointestinal discomfort and pain, he was referred by his physician to a surgeon who diagnosed appendicitis and performed an appendectomy in June, 1935. After a brief period of convalescence he resumed work on the farm and very shortly his former symptoms returned. His suspicions were aroused and samples of the water were sent for bacteriological and chemical analyses. A report issued by the Central Laboratory of the Ontario Department of Health on July 31, 1935, indicated that the water contained 7/10 grain of arsenic, expressed as arsenious oxide, per imperial gallon.

An investigation of the probable source of the arsenic in the water has

been made. Samples of the limestone stratum through which the well is drilled, when subjected to the Gutzeit test, have yielded as much as 15 parts arsenic as  $\text{As}_2\text{O}_3$  per million parts of limestone or 1.05 grains per lb.

A thin section of the limestone shows microscopically interlocking grains of calcite with small brownish particles in the sutures between the calcite grains and at intervals small aggregates of similar brownish particles fading out, without definite boundaries, between it and the calcite. Chemical tests indicate that these particles consist of ferrous arsenate.

The scale from the household kettle which had been in use for a considerable time was removed and examined for the presence of arsenic. A thin microscopic section shows dense aggregation of ferrous arsenate particles embedded in the lime salts. A powdered sample of the scale yielded approximately 4000 parts arsenic as  $\text{As}_2\text{O}_3$  per million parts of scale, or 0.4 per cent. arsenic.

**13. The Resistance of Guinea-Pigs to Lethal Spore Doses of *Clostridium tetani*, Induced by Active and Passive Immunization—DR. P. A. T. SNEATH, E. G. KERSLAKE, B.V.Sc., and F. SCRUBY, Connaught Laboratories, University of Toronto.**

CULTURALLY determinable numbers of toxin-free spores derived from heated and washed broth cultures of *Clostridium tetani* provide an effective lethal spore dose when combined in suspension with an equal volume of 50 per cent.  $\text{CaCl}_2$  and injected intramuscularly into guinea-pigs. In unprotected animals a single viable spore probably induces tetanus from which the animals die within a period of 48-72 hours, an effect similar to that of doses containing numbers calculated to be approximately 150,000 spores per dose. Doses of spores in excess of this may kill in from 43-60 hours. Since in the highest dilutions the chance that a single spore will be present is remote, doses shown by culture to contain an average number of 3 colonies or more capable of being counted separately in semi-solid agar cultures were selected as lethal spore doses.

In 55 normal guinea-pigs receiving a lethal spore dose followed by the intraperitoneal injection of 1,500 units of tetanus antitoxin, 76 per cent. developed tetanus, 38 per cent. eventually died with tetanus, and 24 per cent. were completely protected. In a similar number of animals 4-8 weeks after active immunization with tetanus toxoid, lethal spore doses gave rise to tetanus in 20 per cent., from which 9 per cent. died and 80 per cent. were completely protected.

Blood from 65 normal guinea-pigs pooled in groups of 5 showed the presence of 0.001 unit of tetanus antitoxin. In view of the uniform absence of resistance to lethal spore doses in other animals from the same source and the possible limitations to accuracy of antitoxin titrations, it is probable that this figure has no immunological significance. Individual blood titrations of 52 of these animals 4-8 weeks after active immunization indicate that 0.01 unit of antitoxin is probably the critical level desirable of attainment after immunization. Actively immunized animals showing antitoxin below that level may die

of tetanus although 3 out of 7 were completely protected. Above that level no deaths followed; 13 per cent. developed tetanus but recovered and 87 per cent. were completely protected in a total of 45 animals.

**14. The Relation of Constitution of Medium to the Production of Streptococcus Haemolysin—DR. FREDERICK SMITH, Department of Bacteriology, McGill University, Montreal.**

**I**N the formation of streptococcus haemolysin the peptone is of paramount importance. Streptolysin formation varies with the concentration and kind of peptone, being maximal at a peptone concentration much higher than that customarily employed in culture media. With Neopeptone (Difco) this is in the neighbourhood of 8-10 per cent. The diminution of streptolysin formation with further increase of peptone is referable to a fraction of the digest which is dialysable and soluble in butyl alcohol. Two inhibitory fractions can be distinguished: piperazine and amino acid, of which the former is the more active. By the addition of these fractions to meat infusion, a medium can be prepared which will sustain growth, but which will not yield haemolysin. Of the other factors involved in streptolysin formation, the concentration of dextrose is the most important. Beyond 0.3 per cent. there is an abrupt decline in the yield of streptolysin.

**15. The Streptococcal Antitoxin Content of Human Sera—DR. HELEN PLUMMER, Connaught Laboratories and School of Hygiene, University of Toronto.**

**B**Y means of a skin test in rabbits it is possible to measure the streptococcal antitoxin present in human blood serum.

In a comparison of sera from tropical and temperate zones, it was found that on the average the former possess more antitoxin than the latter. For subjects of all ages, one cubic centimeter of serum contains more than one unit of antitoxin in 63.7 per cent. of 226 Canadian, and in 93.5 per cent. of 107 tropical sera. For subjects under 17 years of age the corresponding figures are 44 per cent. for Canadian and 93.3 per cent. for tropical sera.

A comparison of maternal and infant cord sera showed that cord serum contains, on the average, more antitoxin than maternal blood. In single tests of 92 pairs of such sera, 25 cord samples were greater and 2 less than the corresponding maternal sera. The remaining 65 pairs did not differ significantly.

**16. Infectious Mononucleosis: A Report of Six Cases—DR. E. J. JOHNS, Institute of Public Health, London, Ont.**

**T**HE laboratory diagnosis of infectious mononucleosis has been aided markedly by the development of the Paul Bunnell test for heterophile antibodies in the blood serum of patients suffering from this condition. This test has been performed recently in our laboratory on 51 patients who showed a lymphocytosis and six cases showing a positive reaction were obtained. This report is a record of our results, together with a brief study of the six cases.

**17. The Antitoxin Level in Children After Toxoid**—DR. D. T. FRASER and K. C. HALPERN, *Connaught Laboratories and School of Hygiene, University of Toronto.*

THE purpose of this communication is to report the results of a study upon 244 children between the ages of 5 and 14, originally Schick positive, who have received three doses of unmodified diphtheria toxoid (Lf 15-20) at three weeks' interval. Blood for diphtheria antitoxin assay was drawn at 3, 6, 9, 12, 18 and 24 months after the three injections of toxoid. Approximately one hundred sera are included in each of the groups up to 18 months. The distribution of antitoxin in each of these groups has been graphically represented on a per cent. basis. By this means the response in antitoxin in children to a given diphtheria antigen may be used as a "yard-stick" with which the antigenicity of any other diphtheria antigen may be compared. The distribution of antitoxin in the group of one hundred children artificially immunized and bled at the three-month interval compares favourably with the distribution of antitoxin in 148 adults "naturally immune". By assaying the antitoxin at different intervals of time an accurate gauge has been obtained of the loss in "antitoxic immunity". The validity of this claim can only be substantiated if there is evidence that the children are living in a non-diphtheria environment. Carrier surveys, the paucity of cases of diphtheria and the repeated titrations on individual children indicate that the children are not in a diphtheria environment. When the average antitoxin unitage for each group is calculated the loss in antitoxin over a period of time is evident. The loss between the average unitage (0.33 units) of 100 children three months after 3 doses of toxoid and the average unitage (0.15 units) of the group at 18 months, is 55 per cent.

Practical application of the yard-stick has recently been made in a determination of the antitoxin response to high (Lf 50) flocculating toxoid given in 1 cc. doses one month apart and the response to average (Lf 15-20) flocculating toxoid as compared with the values obtained after three doses. The results indicate that the response to 50 Lf toxoid given in two doses is superior to 15-20 Lf toxoid but much inferior to the response to three doses of 15-20 Lf toxoid given three weeks apart. Thus the figures for the per cent. of sera having more than one one-hundredth of a unit per cc. three months after toxoid are 53, 35, and 96 respectively in reference to two doses of 50 Lf toxoid, two doses of 15-20 Lf toxoid, and three doses of 15-20 Lf toxoid. This comparative study was a co-operative undertaking with Dr. E. Martel of the Ministry of Health, Province of Quebec, who made the injections and obtained the blood samples.

**18. Comparative Study of Dark Ground Illumination and Serological Tests for the Diagnosis of Primary Syphilis**—DR. A. L. MACNABB, *Director, Division of Laboratories, Department of Health of Ontario, Toronto.*

FOUR hundred and seventy-four specimens have been received in the combined dark field outfit. In 406 instances both specimens of chancre serum and peripheral blood were submitted. Of this number, 265 specimens yielded

a positive result in either the dark field examination or in one or more of the serological tests, while 141 specimens yielded negative results in all tests. Of the positive group, the average age for males was 30 years and for females 21 years.

Of the 265 specimens, *Treponema pallida* was found present in 223 (84.2 per cent.). Forty-two (16.5 per cent.) of the cases yielded positive results to the presumptive Kahn test, where the dark field was negative. The dark field examination has proved to be of great value in the diagnosis of early primary syphilis.

**19. Antitoxin Response in Vitamin C Deficient Guinea-pigs—DR. G. D. W. CAMERON, Connaught Laboratories, University of Toronto.**

**G**UINEA-PIGS given vitamin C (ascorbic acid) subcutaneously in a dose sufficient only to maintain life and allow small weight gains, developed lower levels of antitoxin in response to diphtheria toxoid than guinea-pigs given a larger dose of ascorbic acid, sufficient to give good gains in weight and maintain pigs in a state approaching normality.

**20. The Prolongation of Insulin Action—DR. D. A. SCOTT and DR. A. M. FISHER, Connaught Laboratories, University of Toronto.**

**S**OME of the chemical properties of Insulin and of protamine are described. Methods recently reported for prolonging the action of Insulin are reviewed. These include the addition of iron, tannic acid, zinc, protamine, protamine and zinc, a preparation obtained from beef thymus gland, and of spermine and other amines to solutions of Insulin. The effect of the administration of a number of these preparations, particularly those containing protamine or spermine, upon the blood sugar of normal rabbits and dogs is shown in a series of graphs. The stability of protamine Insulin, with and without added zinc, is demonstrated.

**21. Study of Typhoid Carriers among 7,000 Food Handlers—DR. JAMES R. SCOTT, University of New Mexico, Albuquerque.**

**D**URING the ten years 1927-1936, 7,040 specimens were collected from all applicants to the County Health Office for food handlers' health cards. Three hundred and ninety-one of these arrived at the laboratory unfit for investigation. There were 6,621 specimens negative for typhoid organisms, but 20 specimens from 20 individual food handlers were positive for typhoid organisms, representing a specific rate of 604 per 100,000.

The food handlers were classified into groups indicating the type of food handling in which they were, or purposed to become, engaged.

Workers in dairies, farms, and those engaged in milk production and distribution numbered 2,183, among whom 7 were found to be positive typhoid carriers. Food handlers employed in various capacities in restaurants, cafés, hotel dining rooms and similar food-dispensing establishments numbered 2,327, of which number 7 were likewise discovered to be typhoid carriers. Employees of grocery stores and meat markets numbered 629, of whom 1 was found to

be a carrier. Employees of soda fountains and soft drink dispensaries, ice cream parlors and similar places, numbered 440, of whom no individual was detected as a typhoid carrier. Among 732 employees of bakeries, 4 persons were detected as carriers of typhoid. Among a group of persons engaged in miscellaneous types of food handling, such as doughnut makers, tamale makers, empanada makers, vendors of ice cream cones, etc., numbering 749 persons, again 1 individual was detected as a typhoid carrier.

**22. Bacterial Growth in Broth Media in Presence of Silverfoil**—DR. C. SIEBENMANN, *Connaught Laboratories, University of Toronto.*

A PURE silverfoil\* strip placed in broth medium may, by its discoloration ( $\text{Ag}_2\text{S}$ ), serve as an indicator of the formation of  $\text{H}_2\text{S}$  by a micro-organism. No growth inhibiting effect of silverfoil, as determined by quantitative gravimetric and turbidity measurements, was observed for the following organisms in broth medium: *Strep. haemolyticus*, *Pneumococcus Type I*, *Pneumococcus Type II*, *C. diphtheriae*, *C. xerosis*, *C. hofmanni*, *Staph. aureus*, *S. suispestifer* (American), *S. suispestifer* (European), *S. typhi* (Rawlings), *S. paratyphi A* (Kessel), *S. paratyphi A* (Mears), *S. paratyphi B* (Rowland).

The formation of  $\text{H}_2\text{S}$  was found to depend not only upon the micro-organism but also upon the chemical composition of the broth medium. Veal broth containing 2 per cent Parke-Davis Peptone proved to be suitable for testing members of the enteric group for their ability to form  $\text{H}_2\text{S}$ . Active  $\text{H}_2\text{S}$ -producers are: *S. suispestifer* (European), *S. typhi* (Rawlings), *S. paratyphi A* (Mears), *S. paratyphi B* (Rowland).

These results agree with those obtained with lead acetate agar (Kligler). In particular the silverfoil test confirms the exceptional position of the strain Mears which forms  $\text{H}_2\text{S}$  although it belongs to the paratyphoid A group.

The silver test has two advantages over the lead acetate-agar test:

- (1) The discolored silver strip can be kept on record as actual proof of the degree of  $\text{H}_2\text{S}$  formation by the micro-organism under standard conditions;
- (2) By having part of the silver strip extend above the broth, one is able to detect  $\text{H}_2\text{S}$  not only in the medium but also in the air space above it.

**23. Immunity to Ricin acquired by Oral Administration**—DR. A. E. ALLIN, *Connaught Laboratories, University of Toronto.*

THE properties of three commercial ricin preparations were found to be variable. A preparation kept in the laboratory for many years had a very much diminished potency in respect of power to agglutinate erythrocytes as well as its lethal properties for laboratory animals. Rabbits were immunized by the intravenous route; mice by the subcutaneous. The former were able to withstand 2,500 lethal doses. The serum from immune rabbits possesses the property of inhibiting the haemolysin produced by ricin, of passive protection, and of anti-dermonecrotic effect. The potency of the serum may be measured in terms of each of these properties as well as by specific flocculation

\*Johnson Matthey & Co. (Canada), Toronto.

with a solution of ricin. Mice were immunized by the oral route. Serum from these mice neutralized 1,600 lethal doses. The immunity of the progeny of female mice was shown to be derived from the milk of the mother and by placental transfer. Attempts at detoxification without the loss of antigenicity were not wholly successful by the methods of boiling, treatment with formalin, and ultra-violet light.

**24. Diphtheria in Monkeys—DR. D. T. FRASER and DR. A. E. ALLIN, Connaught Laboratories, University of Toronto.**

TWENTY-ONE monkeys (*Macacus rhesus*) were used in this study. The serum of these monkeys contained no detectable ( $< 1/500$  unit) diphtheria antitoxin; none harboured *C. diphtheriae* in the nose and throat. Gravis and intermediate strains of *C. diphtheriae* failed to infect monkeys when sprayed into the nose, pharynx or trachea of four monkeys and no antitoxin was demonstrable in their blood serum subsequent to experimentation. Intradermal injection of living diphtheria bacilli produced lesions from which positive cultures were readily obtainable. In one monkey two intracutaneous injections of living bacilli given one month apart resulted in an antitoxin response after 8 weeks of  $> 1/250 < 1/100$  unit. Living diphtheria bacilli injected into this animal at a time when its blood serum was at the above level failed to produce a lesion in the skin. Monkeys respond readily to the injection of diphtheria toxoid. One dose of alum-precipitated toxoid (Lf 20) produces a much better response than does one dose of high (80) Lf plain toxoid. In the former instance, with one exception, the level was 1/10 unit or greater. In the latter group no animal had more than 1/100 unit. Two doses of high Lf toxoid resulted in a response approximately equivalent to one of alum-precipitated toxoid. Four months after the giving of toxoid the levels of antitoxin in the two groups (4 animals) was not significantly different.

**25. Value of Cortin in Preventing Diphtheria Intoxication—DR. D. T. FRASER and DR. A. E. ALLIN, Connaught Laboratories, University of Toronto.**

THE cortin used in these experiments was supplied by the Connaught Laboratories and contained 30 dog units per cc. The cortin contained no detectable amount ( $< 1/500$  units) of diphtheria antitoxin. When mixed with diphtheria toxin, it failed to inhibit the toxic effect of the latter when the mixture was injected intradermally. When the L+ dose of toxin plus one unit of antitoxin were injected into guinea-pigs which had received 1 cc. of cortin at the time of injection of the toxic mixture, and 1 cc. each following day thereafter, these test animals survived somewhat longer than the control guinea-pigs without cortin. The difference in survival time was considered insignificant. Similarly, cortin when added to the toxic mixture did not prolong life significantly.

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### FOETAL MORTALITY

**I**N view of the wide interest in neonatal mortality and the close association between its causes and those of "stillbirths", the paper on foetal mortality by Dr. Sellers in this issue has considerable practical significance. Pregnancy wastage, so-called, has assumed a greater degree of importance in recent years, as a result of a general and persistent decline in birth rates. Furthermore, efforts in the field of foetal mortality should prove to be of real value in an approach to preventive obstetrics.

A further pursuit of studies of antenatal and intranatal death is desirable, particularly with a view to becoming better acquainted with the causes thereof. It might reasonably be expected that the introduction of a special form for the certification of "stillbirth" in Canada, which would replace the present double system of registration, would serve this purpose well. This would undoubtedly provide an opportunity for specifically interesting the medical profession in this problem by directing their attention more intimately to it and, having done this, it would in all probability offer a source, greatly improved at least, of statistical data on causation and other subsidiary factors not readily available at the present time. Quebec has been using a special form, called form C, since 1932, and it has already proved itself to be a source of extremely useful, practical information in this field.

The study by Dr. Sellers is the first of its kind published in Canada, and while in scope it cannot be compared with the brilliant efforts of Eardley Holland and his colleagues in England, because of lack of autopsy material, it serves to re-emphasize a neglected field of interest. The investigation is based on the special returns dealing with foetal deaths occurring in Ontario public hospitals during 1933 and made in accordance with the Public Hospitals Act of 1931. It is to be hoped that such investigations as this may be made elsewhere in Canada. Particularly is there a need for a careful clinical and pathological study of foetal deaths. Only in this way will the knowledge which we need become available.

## LETTER FROM GREAT BRITAIN

GEORGE F. BUCHAN, M.D., F.R.C.P., D.P.H.  
*London*

### PHYSICAL EDUCATION

THE King's Speech on the Opening of the Autumn Session of Parliament directed attention to the physical welfare of this nation and the need for an increased appreciation of the part which physical education can play in raising the standard of national well-being. The Government have indicated that the necessary measures will be introduced but their nature has not yet been disclosed. The Board of Education for some time now have been directing their efforts to secure adequate instruction in this field. The narrow system of school drill has developed into a balanced scheme of rhythmic movements designed to achieve an easy erect posture and a lithe grace of movement. Increased numbers of sessions are allowed for physical education in secondary schools and, whilst team games are not relegated into the background, it is firmly realised that carefully graded systems of exercises and gymnastics alone will endow the pupils with that supple poise so personally advantageous in everyday life. Opportunities are to be increasingly available for young people who have left school to improve their physical condition through the medium of evening classes. The attendance at such courses is entirely voluntary, as is their provision by local authorities, and the obligatory centralised methods of certain continental powers are condemned as inappropriate in ideal and ineffective in practice. Most large areas now possess the services of a highly qualified organiser of physical training whose duties involve the co-ordination and development of all organised physical exercises and recreations in the area. Much need is recognised for fully qualified teachers of gymnastics

who are finding it increasingly easy to secure suitable posts in schools and similar institutions.

### ANNUAL REPORT OF THE BOARD OF CONTROL, 1935

THIS report is always interesting and some of the phases of the work of the Board are worthy of note.

The Mental Treatment Act of 1930 continues to afford the authority for most of the changes in the care of psychological patients in Great Britain. Voluntary treatment, that is, admission to public mental hospitals without the necessity for prior certification, has increased now to one-quarter of the admissions to these institutions; the rate-aided patients now enjoy privileges previously obtainable only by those who entered private mental homes and were financially responsible for their own maintenance. Temporary treatment enabling non-volitional patients to be detained without the order of a magistrate must be used with caution in democratic England but 5.2 per cent. of the total admissions were in this class and the percentage is increasing. These provisions have been reproduced with or without modification of detail in various Dominion and Colonial enactments and it is noted that in the latest enactment (Rhodesia) temporary treatment is extended to resistive as well as to non-volitional patients.

Out-patient treatment is an essential part of the provision for early mental therapy and it is interesting that a number of local authorities who are providing facilities at their hospitals are staffing the clinics with medical officers from the mental health service. The voluntary hospitals, for the most part, have not availed themselves of this opportunity and consequently

have probably lost any chance of playing a part in the treatment and supervision of mental illness.

The increase in the number of certified mentally defectives still goes on but this is due to better ascertainment rather than any absolute increase of the condition. It is thought that many more could enjoy the protection of the Mental Deficiency Acts if local education authorities would exert vigilance and carry out fully the duties of ascertainment and notification in the ordinary elementary schools.

Social work amongst defectives continues in the provision of evening clubs and day training centres, whilst institutions are now making great efforts to instal cinemas and arrange libraries.

The Board stresses the need for a periodical physical examination of mental patients as a means of bringing to light the first signs of incipient disease and they emphasise that it is equally important as a means of detecting the existence of remediable physical defects which always entail some degree of inefficiency and often considerable discomfort.

#### AIR RAID PRECAUTIONS

CANADA is not likely ever to require to discuss such measures but it may be interesting to my Canadian public health colleagues if I indicate that in England the Medical Officer of Health and other officers of Local Authorities require to take them into consideration.

The Public Health Congress held in London during November 1936 discussed many of the phases of this topic and in the exhibition section large mechanical appliances were on view, conspicuous amongst which were many motor vehicles capable of adaptation for use after air raids as decontamination units for the dispersal of persistent noxious gas and liquids.

It is commonly realised that an almost insuperable burden will fall upon local authorities in England in

the event of an air raid and, whilst no one imagines it possible to foresee and avoid all difficulties, or train fully the necessary additional staff, yet many medical officers and engineers are quietly collecting data and considering executive details of schemes to operate should emergency arise.

The Home Office department of the Government has during the last three months issued six publications on the subject of Air Raid Precautions. Some are addressed to the public or to the owners of large business establishments but the majority concern the work of officials of local authorities.

Local schemes embrace a liaison between the surveyor, the engineer and the medical officer; naturally the last named is concerned with human casualties whether wounded, gassed or merely contaminated by contact with gas clouds or liquid gas. From the voluntary ambulance associations first-aid parties are being recruited who will convey casualties to first-aid or decontamination posts provided by the local authority whence they will be discharged or transferred to specially selected hospitals. Difficulties in the movement and treatment of casualties will, subsequent to any raid, be intensified by the effects of high explosive and incendiary bombs on the general supplies of water, gas and electricity, yet a realisation of the extent of those difficulties will help in their rapid solution in the event of necessity. Liquid mustard, if left in contact with the skin for five minutes, will produce ulceration after a short interval; inhalation of phosgene damages the lungs and results in pulmonary oedema on the mildest exertion; such casualties demand immediate treatment.

The use of poison gas is forbidden by the Geneva Protocol of 1925. Nevertheless, the risk of its being used remains a possibility which is receiving due attention, without, however, the display of panic or undue apprehension.

### THE RISE OF THE MEDICAL OFFICER OF HEALTH

SIR ARTHUR MacNALTY, K.C.B., M.D., F.R.C.P., Chief Medical Officer of the Ministry of Health, gave a very excellent address on the rise of the Medical Officer of Health in England at the Public Health Congress referred to in the preceding paragraph. He pointed out that although the first medical officer of health was appointed less than a century ago, medical officers of health have now become an essential feature of our social system. He traced the development of public health from its beginnings and showed how stupendous has been the growth in the public health powers of local authorities. The medical officer of health has naturally done much to secure this progress.

Preventive medicine to-day takes all medical knowledge for its province. The medical officer of health is no

longer a minor sanitary official, the man with the muckrake "who rakes to himself the straws, the small sticks and dust of the floor." He is responsible for the prevention and in great part for the treatment of disease in all its protean forms by which mankind is assailed. Much is asked of the modern medical officer of health. Apart from good personal qualities and high qualifications, he must be an able administrator and be acquainted from past experience with medicine, surgery and obstetrics, for much of his future work lies in wrestling with their problems and organisation.

The address in its complete form is well worth perusal. The best men in the medical profession are required for the public health service with its untold opportunities and tremendous interest for the medical worker imbued with the desire to advance the cause of preventive medicine.

## PLANS, PROGRAMS, AND PROGRESS

### POISONING BY MUSSELS

THE reporting of two deaths in Digby County, Nova Scotia, in July 1936 which occurred within three hours after eating mussels, drew attention to the possible occurrence of this rare form of poisoning. Dr. P. S. Campbell, Chief Health Officer of Nova Scotia, conducted an investigation and a detailed study was made by Dr. Norman MacL. Harris, Chief of the Laboratory of Hygiene, Ottawa. This is the first record of any Canadian shellfish producing a poison. The investigation showed that four or five other persons suffered severe illness but recovered.

Investigation of similar cases of poisoning by mussels was made by Dr. Karl Meyer, of the University of California, several years ago. During the months of June to September mussels in certain places on the Pacific coast have been found poisonous; at other times of the year they were not and could be eaten safely. Dr. Meyer

has shown that the shellfish remain poisonous after cooking. The poison is one of the most powerful known, as evidenced by the fact that in laboratory tests .0000017 gram will kill a mouse in fifteen minutes. Dr. Meyer showed last year that the explanation of the seasonal poisoning lies in the fact that during the summer months a certain dinoflagellate organism is present in considerable numbers in the stomachs and digestive glands of mussels. This flagellate contains the poison and through the ingestion of these organisms the mussels become poisonous during the summer months. Samples of the Canadian mussel were sent to Dr. Meyer for study. Dr. Harris, in his report, draws attention to the fact that the hard shell clam on the Pacific coast has been found also to be poisonous. The sand crab on the Pacific coast also ingests this organism but it has not been ascertained whether the sand crab is ever used as food. The soft mussel or clam is not poisonous.

and no evidence of poisoning from oysters either on the Pacific coast or on the Eastern coast has been found.

#### INAUGURATION OF THE VANCOUVER METROPOLITAN HEALTH BOARD

**T**HE work of the Metropolitan Health Board is now well under way. Dr. A. R. J. Boyd, D.P.H., has been appointed to the constituent health unit of South Vancouver; Dr. K. F. Brandon, D.P.H., to the Point Grey and University area; and Dr. A. M. Menzies, D.P.H., to one of the central area units. Dr. J. S. Cull, D.P.H., of Pouce Coupé Unit, British Columbia, will become associated with the Board early in January. Miss M. P. Campbell, Miss O. E. Kilpatrick, Miss E. Stoddart, and Miss G. Humphrey have been appointed supervising nurses of the units. Miss M. Upshaw has been appointed assistant supervising nurse for Richmond. Promotions recommended include Miss E. M. Elliott to be divisional supervising nurse in charge of tuberculosis; Miss L. M. Sanders to be divisional supervising nurse in charge of child welfare; and Miss M. C. McLellan, in charge of school nursing services.

#### HEALTH INSURANCE IN BRITISH COLUMBIA

**O**WING to unforeseen difficulties in completing registrations for health insurance and in details of collecting levies in certain classes of seasonal workers, together with the volume of work entailed in placing the plan in operation, Mr. Allon Peebles, Chairman of the Commission, does not anticipate the operation of the plan before March 1st at the earliest. The Commission is expected shortly to announce the details of the medical services.

#### AN IMPORTANT APPOINTMENT IN THE DEPARTMENT OF INDIAN AFFAIRS, OTTAWA

**P**UBLIC health workers throughout Canada will be pleased to learn of the appointment of the Honourable

Mr. R. A. Hoey as Director of Welfare and Training Services of the Indian Affairs Branch, Ottawa. Mr. Hoey served for nine years as Minister of Education in Manitoba and for several years as Minister of Health.

There are at present 79 residential schools, 262 day schools, and 10 combined Indian and white schools in operation in the Dominion, with a total enrolment of 17,560. Serious consideration is being given to the most desirable type of education for Indians. During 1935 \$1,655,820 was expended on Indian education.

In the matter of health also, Mr. Hoey is intimately acquainted with the problem of tuberculosis and with the efforts which have been made in Manitoba and in the other western provinces to deal with this disease.

#### SCARLET FEVER IMMUNIZATION IN EDMONTON

**F**Ollowing the prevalence of scarlet fever in Southern Alberta, Dr. R. B. Jenkins, D.P.H., Medical Officer of Health of Edmonton, has enlarged the program of immunization which he has been conducting against scarlet fever and diphtheria. In November 12,000 request forms relating to scarlet fever immunization were distributed among the school children. Dr. Jenkins plans to conduct the immunization in the public and separate schools throughout the city. Physicians are co-operating and are prepared to give the treatment privately if parents so desire.

#### MILK COSTS SURVEY IN ONTARIO

**T**HROUGH the co-operation of the Economics and Dairy Husbandry departments of the Ontario Agricultural College and the Economics Branch of the Dominion Department of Agriculture, with the co-operation of the milk producers' associations, a study is being made of the cost of milk production in Ontario. The active support of more than 1,500 individual milk producers has been obtained. Each producer has been supplied with

an account book. During the year representatives will call on each of the farmer-producers to provide any desired assistance in the keeping of records. The study promises to be of material assistance to the milk producers in their discussions in regard to the price of milk.

#### SCARLET FEVER IMMUNIZATION IN FOOTBALLS HEALTH UNIT, ALBERTA

**A**N active program for the control of scarlet fever is being conducted by Dr. A. Somerville, D.P.H., among the 3,500 school children and the 3,000 children of preschool age in the area served by the unit in southwestern Alberta. Five hundred children have received five inoculations, 367 are receiving treatment, and 119 children tested were found to be Dick-negative. Among the high school students in Manton, one-third were found to be Dick-negative. The percentage of Dick-positive children is considerably greater among young children. In carrying out the work, the schools have been grouped in areas and one school used as a central point, obviating the school-to-school visitation. It is planned to conduct a widespread diphtheria immunization and smallpox vaccination campaign next fall.

Under the direction of Miss Helen McArthur, Reg.N., public health nurse, effective public health education is being conducted among school children and interest is evidenced in the publication of a school magazine which is distributed through all the schools.

#### TUBERCULIN TESTING OF CATTLE IN NEW BRUNSWICK

**M**R. J. K. KING, Deputy Minister of Agriculture in New Brunswick, recently announced that the province will complete its tuberculin testing of cattle in March, 1937. Thus New Brunswick will be the second province in Canada to become a tuberculosis-free area so far as its cattle are concerned, Prince Edward Island being the only other province

to have completed this work. The percentage of reactors has been very low, there being only 29 reactors in 25,000 cattle recently tested. The percentage of reactors in the 206,000 cattle tested to date is only one-tenth of one per cent.

#### ERECTION OF THE ST. LAWRENCE TUBERCULOSIS SANATORIUM AT CORNWALL, ONTARIO

**W**ORK was commenced in November on the new St. Lawrence Tuberculosis Sanatorium at Cornwall, Ontario. The institution, which will face the St. Lawrence River, is five and a half miles east of Cornwall and will occupy a site 600 by 1,000 feet. The Ontario Government will contribute \$100,000; the united counties of Stormont, Dundas and Glengarry will contribute an equal amount; and the balance of the estimated cost of \$225,000 will be sought through public subscriptions. On completion the sanatorium will serve the united counties but will also be open to patients from other districts if accommodation is available.

#### PERSONALS

**A**n expression of appreciation of the excellent progress being made in public health in British Columbia is contained in a recent letter from Dr. John A. Amyot, C.M.G., formerly Deputy Minister of Pensions and National Health of Canada, who recently spent several months in Vancouver with his son, Dr. G. F. Amyot, D.P.H., Assistant Provincial Health Officer. Dr. Amyot is planning to spend the winter in California. Letters addressed in care of Dr. G. F. Amyot, 712 Standard Bank Building, Vancouver, will be forwarded.

Dr. Alphonse L'Esperance of Quebec has been appointed Medical Superintendent of the Lake Edward Sanatorium. His assistant is Dr. Arthur Thibault of Victoriaville. Dr. L'Esperance has been affiliated with some of the leading hospitals both abroad and in Quebec.

## ASSOCIATION NEWS

### CHRISTMAS MEETING OF THE LABORATORY SECTION

WITHOUT question, the success of the fifth annual Christmas meeting of the Laboratory Section, held in the Royal York Hotel, Toronto, on December 21st and 22nd, indicates not only that there are many important pieces of research being conducted in the universities and other institutions but also that there is a keen interest on the part of bacteriologists and pathologists in meeting together for the presentation of papers and for discussion. The Laboratory Section publishes annually a directory of Canadian laboratory workers, in which are included the names of 225. Approximately 100 were in attendance at the meetings. Members were present from British Columbia, Manitoba, Nova Scotia, and from many centres in Ontario and Quebec.

Twenty-five papers were presented at the three sessions. Of outstanding interest was the address of Dr. R. E. Dyer, Senior Surgeon of the United States Public Health Service, Washington, on diseases of the typhus fever group in North America. Dr. James R. Scott of the University of New Mexico, Albuquerque, discussed findings in a study of typhoid carriers among food handlers.

A feature of the meeting was the holding of a dinner session on Monday evening. Dr. Ronald Hare, late of the Queen Charlotte Hospital, London, and now a member of the Connaught Laboratories, University of Toronto, presented some results of his extended studies on puerperal sepsis; Professor G. B. Reed, of Queen's University, introduced the subject of sub-acute bacterial endocarditis and discussed the current views in regard to this condition; and Professor E. G. D. Murray of McGill University brought to the meeting the importance of an active interest in bacteriological nomenclature. Reports were

presented by the chairmen of the various committees of the Section.

The luncheon session has become the formal occasion of the meeting and the Section was most fortunate in having as guests both the Honourable J. A. Faulkner, M.D., Minister of Health, and Dr. B. T. McGhie, Deputy Minister of Health of Ontario. Dr. Faulkner spoke briefly of the importance of laboratory work in the provincial health service and congratulated the Section on the convening of this annual meeting. Dr. McGhie, as guest speaker, spoke of the problem of mental defectives in Ontario.

As in former years, provision was made for the presentation of new laboratory methods and the demonstrations included procedures of practical value to many laboratory workers. It is hoped that not only will the demonstrations be a feature of increasing importance but that exhibits will be prepared which can be studied during the meeting.

The publication of abstracts of all the papers presented was an innovation which the Section purposes to continue as a policy for future meetings. It is expected that many of the papers will be published in full in the *JOURNAL* during the coming months.

The members of the Section in attendance received also the second Bulletin published by the Section dealing with new laboratory procedures. Copies of this bulletin may be procured by writing to the Association's office.

The following officers were elected for 1937: Chairman, Dr. A. J. Slack, London; Vice-chairman, Professor E. G. D. Murray, Montreal; Secretary, Dr. G. D. W. Cameron, Toronto; Section Council, Dr. M. H. Brown, Toronto, Dr. Wm. J. Deadman, Hamilton, and Dr. J. H. Orr, Kingston.

## CURRENT HEALTH LITERATURE

*These abstracts are intended to direct attention to articles that have appeared in other journals during the past month. Any of the journals referred to may be borrowed for three days or longer if desired. Address requests to the secretary of the Editorial Board.*

### Role of Syphilis of the Nervous System in the Production of Mental Disease

ACCORDING to the authors the amount of mental disease due to syphilis of the nervous system has never been accurately appraised. An analysis of the records of the Boston Psychopathic hospital, receiving a representative cross-section of cases occurring in the community, showed that during the years 1912 to 1936 9.3 per cent of 26,437 first admissions with psychoses had syphilis of the central nervous system.

M. Moore and H. H. Merritt, J.A.M.A., 1936, 107: 1292.

### Investigations on Respiratory Dust Disease in Operatives in the Cotton Industry

EXPOSURE to dust in the course of the early stages of the manipulation of cotton is a cause of considerable discomfort and ill health. When the exposure is continued over a period of years operatives are liable to develop an occupational asthma which later becomes complicated with chronic bronchitis and emphysema. The injurious element in cotton dust is a protein which produces a state of allergic sensitivity and also has a characteristic irritating effect upon the deeper tissues. Allergy to this protein is shown by diseased cotton workers, but is rare in normal persons and patients suffering from spasmodic asthma. Treatment by desensitization is unsatisfactory and only removal of the dust hazard will prevent the disease.

C. Prausnitz, Medical Research Council, Special Report Series, No. 212, 1936. (Published by His Majesty's Stationery Office, London.)

### The Clinical Diagnosis of Amoebic Dysentery

HISTOLYTICA is widely disseminated through the United States and is responsible for a variety of clinical manifestations ranging from "simple diarrhoea" to major surgical conditions. Amoebic infection must thus be considered in the diagnosis of a wide variety of clinical conditions. Negative laboratory reports are of little value and the authors believe that a more frequent application of the therapeutic test with a specific amoebicide would aid in the diagnosis of suspected cases. Finally, it is urged that a greater effort be made to arrive at an aetiological diagnosis of the diarrhoeal diseases.

George W. McCoy and Albert V. Hardy, J.A.M.A., 1936, 107: 1357.

### Practical Epidemiology of Syphilis

THE author advocates a more concentrated effort in attacking the rapidly increasing incidence of syphilis in the United States. He advocates serologic surveys of population groups and also "mass sterilization" of infected persons (sterilization meaning rendering the person non-infectious by anti-syphilitic treatment) as was done among the Negro population of the South by the U.S. Public Health Service a few years ago. The policy of the University of Virginia Hospital is to investigate epidemiologically all early and familial cases of syphilis. In getting the co-operation of the patient and contacts secrecy is all important. The public health nurses are instructed especially to stress the medical and minimize the moral aspects of the disease. In his clinic the author is able to report that 41.2 per cent of patients returned for the minimum standard of treatment.

Dudley C. Smith, J.A.M.A., 1936, 107: 784.

